Volume 16, No. 3
May-June
1961

Forage Dynamics
in Soil Conservation

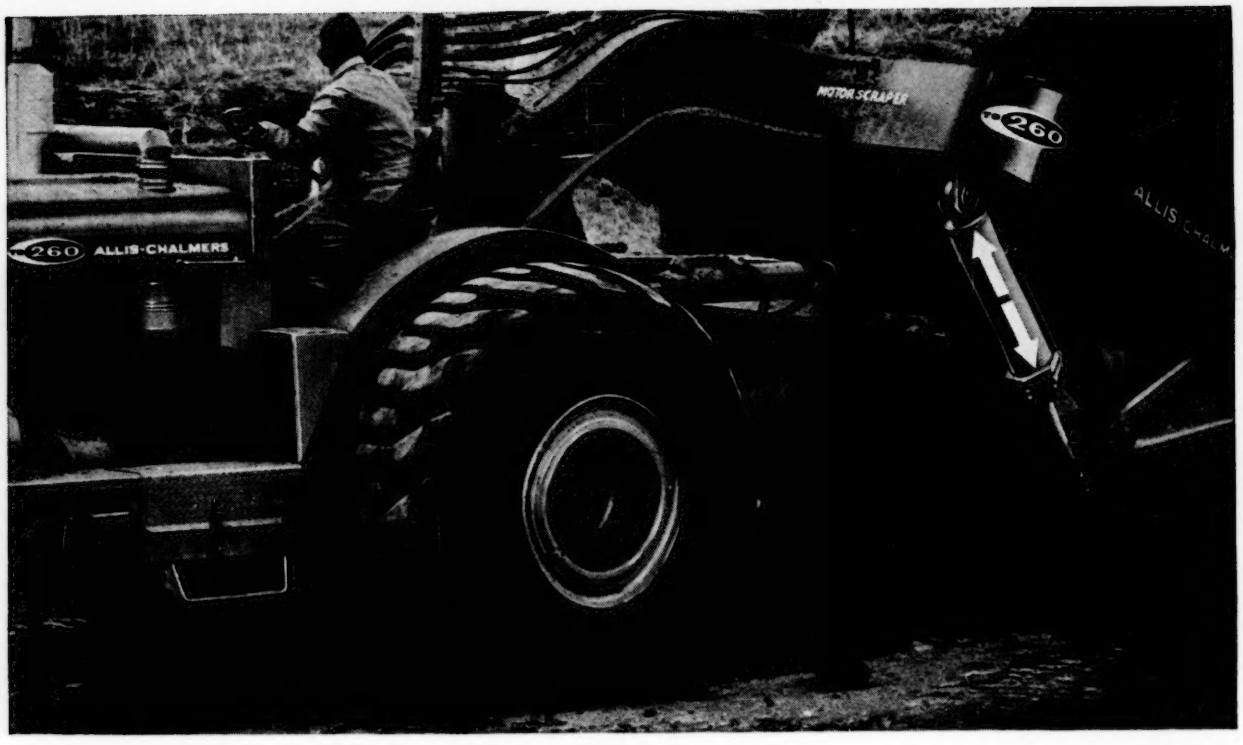
Effective Use of Water
in Agricultural Areas

Cost Share Principles—
in the Great Plains

A City Manages
Forested Watersheds

Hugh Hammond Bennett
and Soil Conservation

A Douglas Fir Tree is Planted on the Grounds of the Society's Permanent Home.



GET POSITIVE PENETRATION AT CUTTING EDGE

The all-hydraulic TS-260 is the only motor scraper in the medium-size class with double-acting bowl jacks that provide 2-way power for faster loading, more cutting control.

The TS-260's exclusive hydraulic down pressure penetrates quickly into the toughest-loading materials. Penetrating force like this — along with Allis-Chalmers original low, wide bowl — gives you fast heaped loads every pass.

Slope-cutting is another good example! "Cornering-in" with bowl down pressure lets your operator sink his bit *when and where he wants* . . . lets him maintain the best cutting depth while loading. The result: Clean, accurate slopes.

Positive penetration is only one reason you'll get top performance on any size job. *Two-stage steering — forced ejection and highest apron lift — 90° steer and* KON-TORK *differential* are earth-moving advantages you cannot afford to overlook.

Put this 230-hp TS-260 to work for you. Move more dirt per dollar invested than ever before.

KON-TORK is an Allis-Chalmers trademark.

move ahead with

ALLIS-CHALMERS

. . . power for a growing world

TO ADVANCE THE SCIENCE AND ART OF GOOD LAND USE

JOURNAL OF SOIL AND WATER CONSERVATION®

May-June 1961 Volume 16 Number 3

IN THIS ISSUE:

Forage Dynamics in Soil Conservation
MAURICE E. HEATH 105

Effective Use of Water in Agricultural Areas
GEORGE M. BROWNING 111

Cost Share Principles Under the Great Plains Conservation Program
T. A. NEUBAUER 116

A City Manages Its Forested Watershed Lands
WALTER C. SUSHKO AND IRVIN G. REIGNER 119

Hugh Hammond Bennett, His Influence on Soil Conservation
T. S. BUIE 123

Book Reviews 127

Literature Briefs 131

Notes From the Field
Rocks, Nature's Gift to the New England Farmer 133
Soil Moisture as Related to Drainage 134
Land Use Changes in the Pine River Watershed 136

Society Affairs 138

News Notes 145

Member News 146

Chapter News 147

The JOURNAL is the official publication of the Soil Conservation Society of America, Inc. Copyright, Soil Conservation Society of America, Inc., 1961.

OFFICERS AND COUNCIL

WALTER C. GUMBEL.....*President*
R. D. HOCKENSMITH..*First Vice-President*
GEORGE BROWNING *Second Vice-President*
HOWARD F. BARROWS.....*Treasurer*
ELMER L. SAUER.....*Ex-Officio*
HERBERT A. HOPPER (*Western*).....*1961*
HAROLD M. RHODES (*At Large*).....*1961*
N. R. RICHARDS (*Canada*).....*1961*
B. K. GERAGHTY (*Great Plains*).....*1962*
W. J. HUDDLESTON (*Southeastern*)...*1962*
A. L. PATRICK (*At Large*).....*1962*
E. D. BOLTON (*At Large*).....*1963*
MINOTT SILLIMAN, JR. (*N. Central*) *1963*
D. J. SACCO (*Northeastern*).....*1963*

H. WAYNE PRITCHARD
Editorial Director and Executive Secretary

WALTER E. JESKE
Editor and Assistant Executive Secretary

FELIX SUMMERS
Contributing Artist

EDITORIAL REVIEW BOARD

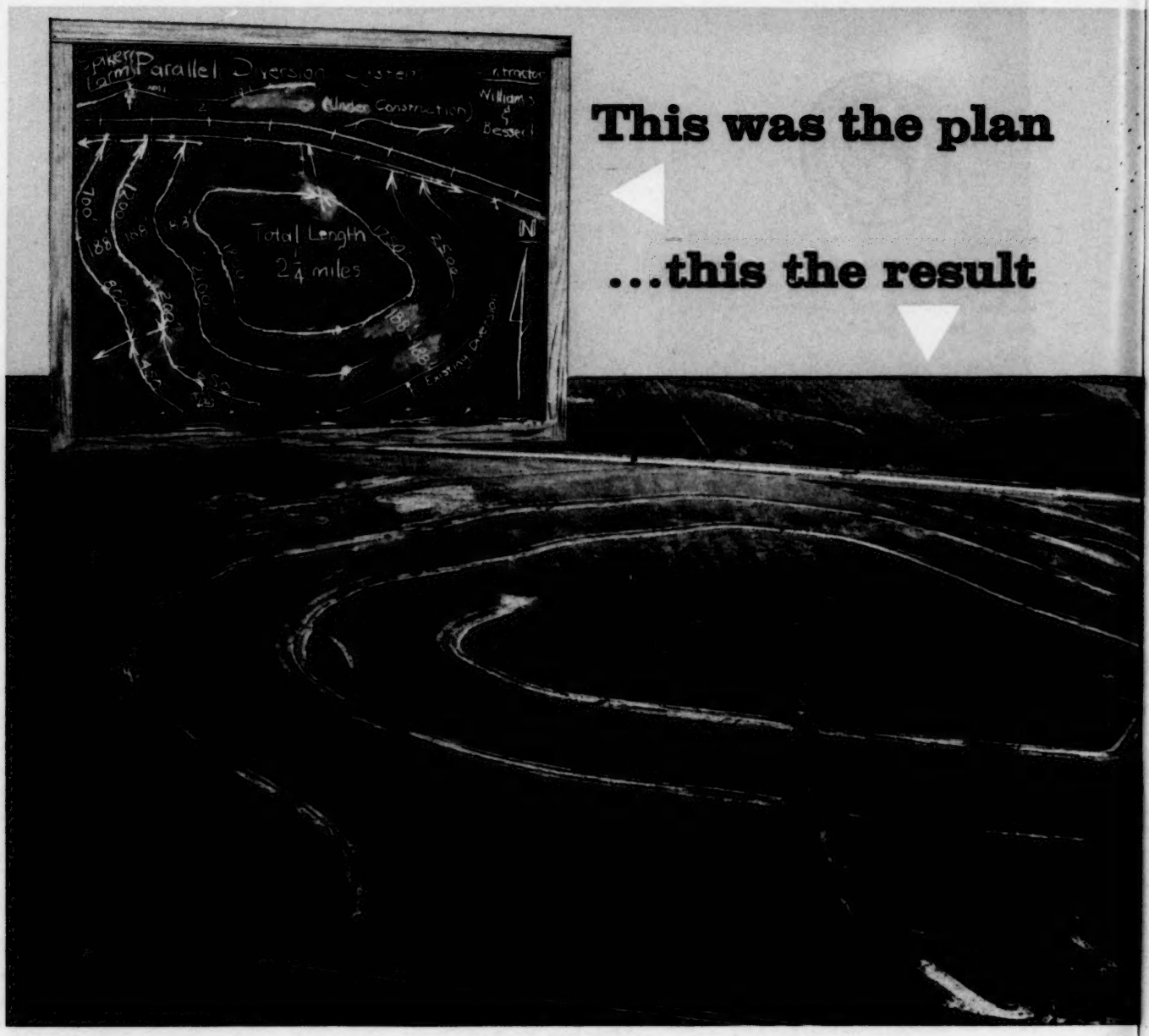
WILLIAM C. ACKERMANN, Urbana, Illinois
MAURICE L. DUMARS, Washington, D. C.
HORACE J. HARPER, Stillwater, Oklahoma
EDWARD A. JOHNSON, Columbus, Ohio
RAMON L. KENT, Spokane, Washington
JOHN LAMB, JR., Venice Center, N. Y.
FRANK H. MENDELL, Des Moines, Iowa
BEN O. OSBORN, Washington, D. C. (Chr.)
J. R. SASSER, Nashville, Tennessee

COVER: Frank Mendell, chairman of the Society's Housing Committee, and Kirk Fox, chairman of the Agricultural Committee of the Des Moines Chamber of Commerce, plant a tree, grown by Mendell on his farm, on the grounds of the Society's permanent home.
Des Moines Register and Tribune Photo

MEMBERSHIP: Annual membership is on a calendar year basis and is $7.50 of which $2.50 is for the JOURNAL OF SOIL AND WATER CONSERVATION. Institutional membership for libraries and others is $7.50 per year. Single copies are $1.25.

CHANGE OF ADDRESS, BUSINESS, ADVERTISING, AND EDITORIAL CORRESPONDENCE should be sent to the JOURNAL OF SOIL AND WATER CONSERVATION, Soil Conservation Society of America, Inc., 838 Fifth Avenue, Des Moines 14, Iowa.

POST OFFICE ENTRY: Second class mail privileges authorized at Des Moines, Iowa.



This was the plan

...this the result

...and how it was accomplished

Parallel terracing was the most practical answer to a severe erosion problem on a Central Illinois farm. This 120 acre field consisted of rolling land with long, even slopes falling at the rate of about four feet per hundred. Soil is brown silt loam of a loess type, highly productive, but subject to erosion unless properly managed.

To overcome this problem, topographical surveys were made by SCS technicians for the McDonough County Soil Conservation District and the plan you see illustrated above was initiated. The plan specified a system of broad-based parallel terraces, spaced 188 feet apart from ridge to ridge, which provided for 56 corn rows planted 40" apart between each terrace ridge. The parallel construction eliminated point rows, and provided an even number of rounds for 4-row planting and cultivating equipment. Terraces were of the flat channel type: wide enough for 4 rows of corn planted on either side of the ridge, 4 rows in the channel and 4 rows on the channel slope.

Typical Broad-base Terrace

This job required the services of a conservation contractor with his D6 and No. 60 Scraper, and a Cat Motor Grader.

The D6 and scraper made a well-balanced and versatile self-loading team that scooped up the earth on high spots and filled in the low places. Parallel terracing called for more earthmoving than conventional terracing, since natural contours did not run at parallel intervals. Further, contours that made extreme point rows or corners too sharp to turn with big cultivating equipment were "smoothed out" by filling in with earth.

Next step was to blade the terrace to the required shape. This, the Cat No. 12 Motor Grader did with efficiency and precision.

The idea of parallel terracing is catching on all over the country. It is the natural answer to the farmer's need to use larger equipment so that he may farm more efficiently and use less labor.

Your challenge — and opportunity — to make more money. Conservation contractors have a challenge to show the farmer how he can successfully use big equipment and still safeguard his land against erosion.

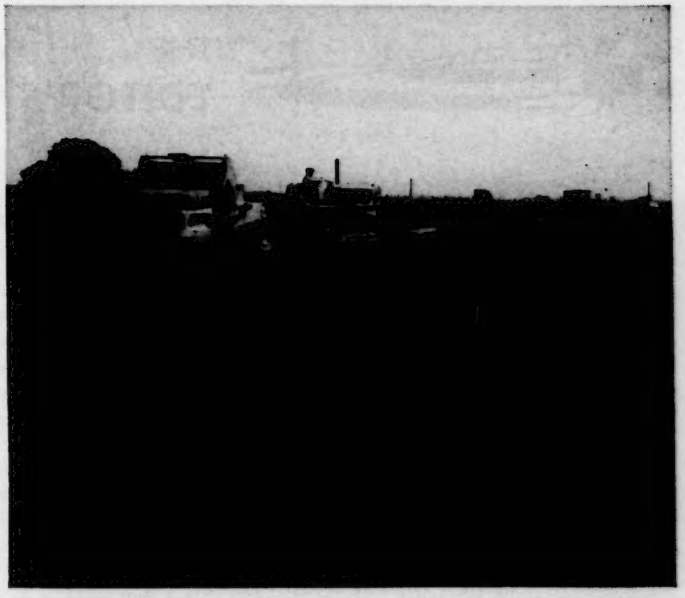
To meet the challenge of more conservation earthmoving—and to make more money—you'll need efficient equipment expressly designed for the job. Here's what to look for: machines that are built for tough work and long life—machines that deliver more work time—less down time.

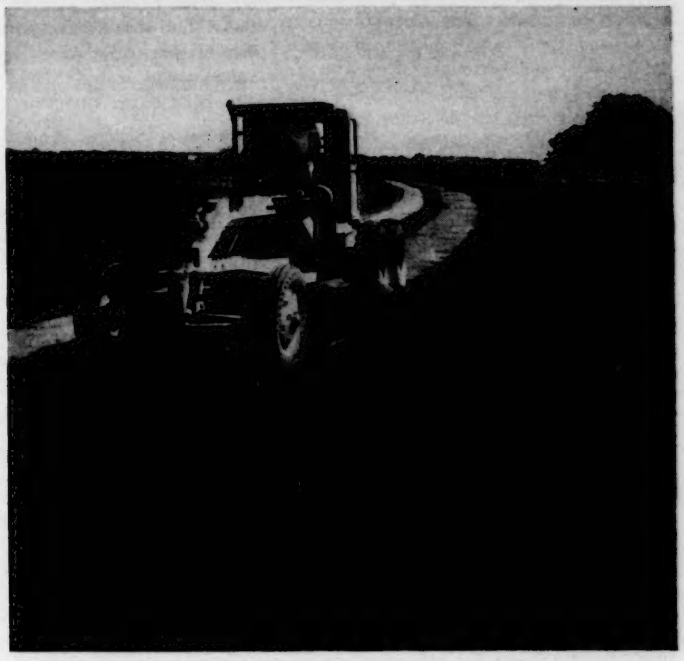
Conservation work needs the go-anywhere, do-anything usefulness of a Cat track-type Tractor. And nothing can equal a Cat Scraper or Motor Grader for brute strength. They are machines designed for precision operation in every soil condition.

Conservation requires equipment with lowest final costs—good cost records will prove Caterpillar machines cost substantially less to own and operate over the years.

Look to the last cost first, consider versatility and all-around usefulness, consider money making ability and you'll own Caterpillar-built equipment. See your Caterpillar Dealer for complete details.

CATERPILLAR TRACTOR CO., GENERAL OFFICES, PEORIA, ILLINOIS, U.S.A.





CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Needed by 1975: 123,300 new dams, tens of thousands of miles of terraces, over 100 million additional farm acres under soil conservation.

FREE LITERATURE

Caterpillar Tractor Co.
Dept. LW-61, Peoria, Illinois

Send in coupon for samples of this literature. If you like what you see, ask your dealer for copies for your customers.

☐ Build 'Em Parallel ☐ From Plan to Profit

Name_____

Address_____

City_____ State_____

THE EDITOR'S MAIL

To the Editor:

The professional conservationist often has difficulty in giving lucid expression to his concepts of the development, use, and conservation of natural resources. Frequently motivated by intentions that are often sharply at variance with "market place" economics he experiences difficulties in expressing his feelings and is often frustrated by the passivity his opinions receive among social scientists.

A. Allan Schmid, in his paper "Aspects of Conservation—Political, Social, Economic," published in the March-April JOURNAL, has performed a noble service, particularly to conservationists, by providing a rational foundation for, and giving forceful and sympathetic expression to concepts of conservation not generally understood and too rarely explored in depth. And, while some economists may argue that there is nothing really new in Schmid's basic economic philosophy, they must admit that Schmid has stimulated and enriched economic thought as it relates to conservation—at least for many conservationists.

Too often, the conservationist—physical scientist or technician that he usually is—becomes frustrated and even emotional, when confronted with the realities of the social, economic, and political forces that inevitably come to bear upon his profession. Schmid's paper, dealing with all these aspects of conservation, will surely help the conservationist to understand that even in his field, "what is one man's sauce may be another's poison," and that the resulting conflicts are resolved through compromise, and moreover that the compromises usually have strong political and economic biases.

Yet one is not entirely economically sanctified by Professor Schmid's fine paper. One can agree that, in our free enterprise society of the past, the price of a product was a function of supply and demand. However, to broadly apply this concept in rationalizing modern conservation seems to ignore such contemporary economic phenomena as "fair trades pricing," "administered prices," "planned obsolesence," "identical bidding," "manufactured wants," "price leadership," etc.

The concept of "value productivity" suffers, then, the same innate naiveness, plus a few other fallacies, when it is applied to conservation of the Nation's aggregate natural resources. Schmid very aptly points up some of the problems involved in the application of the concepts of physical and value productivity as applied to conservation. But, something else needs to be said. One can illustrate the point by paraphrasing a simple illustration given in Volume I of the 1950 report, "A Water Policy for the American People." Suppose that on Christmas day the total forest resources of America had a money value of 80 billion dollars. Suppose further, that on New Year's day fire destroyed half of these forests. It is not at all inconceivable —in fact it is very likely—that by Washington's birthday, the value of the remaining forests, reflecting the scarcity of forest products, would again be at least valued at 80 billion dollars. Thus it is that, while the Nation would have suffered a resource loss of disastrous proportions, the dollar-value would scarcely have been affected. The point seems obvious.

Professor Schmid seems to be on firm ground in such statements as "Investment in preservation and development means less of other goods in the future. Conservation can only change the composition of future goods and materials." This is heady material—yet, imagine the substitution, let us say, of cotton fibers for paper pulp if we "hoarded" or depleted forest resources to the extent that this became necessary. So, while these truisms possess real substance, one can argue with some degree of validity that "Mr. Clean" of television fame also has changed the composition of future goods and services.

One might prefer to think of conservation as embracing not only concern for the future, but also the elimination of waste and a continual search for more efficient use of resources as a means to a fuller, more abundant life for the present, as well as over time.

With respect to the social and political aspects, the two conservation policy guides suggested by Dr. Schmid may be the best that can be devised by a "market place" oriented society. The concept of "a minimum safe standard to prevent a rate of use beyond a point where a renewable resource cannot be restored to a greater level of productivity," is certainly sound policy. However, and as recognized by Dr. Schmid, "One cannot assume that third parties (the various elements of the public) affected by a resource use transaction will automatically be able to form a political action group so that their interest will bear on the use."

In other words, the third party (public) in such a transaction is pitted against an entrenched soulless "market place." In this setting, the concept of "minimum safe standard" has an element of brinksmanship that gives the conservationists great concern. They feel that negotiations of the public versus a combine of the buyer and the seller, as regards the Nation's natural resources, can lead to a "minimum safe standard" that is only a short step away from the point of no return.

In this regard, the conservationist, and indeed the citizen himself, ask discomforting questions:

"Are streams flowing with floating excrement and other sewage solids—with gas bubbles from sludge deposits rising to the surface—to be freed from defilement only to the extent that is economically feasible?"

"Shall a society (Schmid's third party) preserve wild creatures of the forests, fields, and streams only after they have become so rare as to make their flesh, fur, or feathers a quaint commercial oddity?"

"Shall our water resources remain undeveloped until consumer preference brings on a substitute product?"

"Does not, in the aggregate, a Nation's resources have security value if they are so plentiful as to be cheap?"

Finally, "do not such projects as the small watershed program—which in sum total may lead to a reduction in dollar-value of a specified crop, simultaneously develop a stronger Nation?"

These questions Professor Schmid has not answered satisfactorily for conservationists. He has marched up to the precipice and endeared himself to conservationists who admire his intellectual stroll. Perhaps he is poised for descent. Until he does so, some conservationists through deep conviction and even with some emotion will continue to crusade and even cauterize the brotherhood with the "God Save the Elk" branding iron.

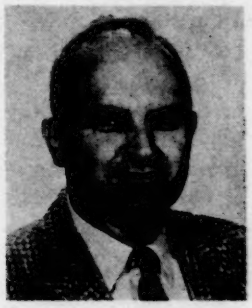
One would not wish to put words into Professor Schmid's mouth. He possesses high capacity to express himself adroitly, but in reading his most constructive paper some conservationists wil want to conclude he shares the philosophy of the Dutch-born British writer, Bernard Mandeville, (1670-1733), who for his own age wrote "The first desirable Blessing for any Society of Men is a fertile Soil and a happy Climate, a mild government, and more Land than People."

—J. RALPH SASSER

(Continued on page 150)

Forage Dynamics in Soil Conservation

MAURICE E. HEATH



Considered collectively, forages are the largest food producing crop in the United States. Best estimates show on-the-stem grazings furnish more than half the total feed requirements of all livestock in this country (14). Animal products currently furnish 67 percent of the protein contained in the U. S. citizen's food supply. Nearly two-thirds of an individual's calcium supply comes from dairy products, largely derived from calcium rich forages (4). Through animals, we are now consuming forages at the rate of nearly 5 tons of hay per capita each year.

FORAGES ARE THOSE PLANTS, mainly the economic grasses and legumes, either grazed or harvested for animal feed. Forage dynamics in soil conservation is the active power and strength of the adapted grasses and legumes when properly used to conserve and improve soil. One facet of this power comes from the dense canopy furnished by these plants and their great efficiency in dissipating raindrop energy. The speed of the raindrop falling through space ranges from 6 to 20 miles an hour depending on its size (8). It has been calculated that the energy from an inch of rain may exceed 2 million foot-pounds an acre (18). This amount of energy is sufficient to raise a 7-inch acre of soil one foot. Ellison has shown splash erosion on bare soil to be one of the prime causes of soil erosion (2). Not only does the dense forage canopy dissipate the raindrop energy but it may intercept as much as 30 to 50 percent of the rainfall during the growing season (3).

In extensive runoff studies conducted by the United States Department of Agriculture and state experiment stations, forages have been found to be 200 to 2,000 times more effective in preventing soil losses than "up and down hill" clean cultivated row crops, depending upon crop management, slope, soil type and character of the precipitation. An example of the effectiveness in reducing soil and water losses of forages such as red clover and bluegrass is shown in table 1 (5).

High quality, productive grass-legume combinations are one of the best materials available to the soil conservation engineer and the farmer when planning and fabricating conservation practices on the land. Frequently the runoff from grass areas is clear as compared with the silt laden runoff from cultivated fields. When turned under for row-crop production, grass roots furnish protection to the soil surface by holding and binding soil particles together and increasing percolation. Missouri workers found that it took nearly 7 times as many water drops falling 30 centimeters to disperse soil aggregates from 13 year alfalfa and 2 year meadow as it did to disperse them on fallow and continuous corn land (13). The effectiveness of the forage mixture depends on the top growth furnishing the soil cover and the roots increasing the soil's resistance to movement and its ability to absorb water. To date, experimental results have shown that outside of forest lands, productive forages are the most efficient crop as a protector and stabilizer of soils on sloping fields.

TABLE 1

Soil and Water Losses Under Various Types of Vegetative Cover and Without Cover on a 16-percent Slope at LaCrosse, Wisconsin—1933-1938.

Type of Cover	*Annual Runoff Percent*	*Annual Soil Loss Tons*
Continuous Corn	29.2	117
Rotation—C-O-Cl. (average)	17.0	27.8
Corn	20.6	52.9
Oats	18.9	29.8
Red clover	11.5	.68
Bluegrass (ungrazed)	5.5	1.0
Fallow	29.0	191.0

Forages and Livestock

In this day of intense economic competition forages as a crop *must* be profitable. Before forages have any general commercial value and in order that they may be used on a wide scale for purposes of soil conservation, they *must* be converted by animals to products for human use. The *forage conversion value* is the gross value of the animal product produced from forage on a given unit of land. Presently, animal products supply about half our food needs and they are basic to our national diet.

This article by Maurice E. Heath is a slightly revised version of a paper presented by him at the Fifteenth Annual Meeting of the Soil Conservation Society of America.

Mr. Heath is associate professor of agronomy at Purdue University Lafayette, Indiana. The Sixteenth Annual Meeting of the Society is to be held at Purdue University, July 30-August 2, 1961.

Forage and Animal Resources of North Central States

For purposes of analysis the States of Missouri, Illinois, Indiana, Ohio, Iowa, Minnesota, Wisconsin and Michigan comprise 15 percent of the land area of the United States and within their borders is found 50 percent of the Class I land of the Nation.

In 1959, this land was utilized as follows: 63 million acres of row crops (46.9 million acres of corn, 15.5 million acres of soybeans, and 0.7 million acres of sorghums); 27 million acres of small grains; and 74 million acres of hay and pasture. Of the latter, 36 million acres are largely unimproved pasture, much of which has a very low animal product output per acre. Rotation forage occupies 38 million acres of tillable land giving an overall ratio of 1 acre of forage to 1⅔ acres of row crops.

In this region are found 30 percent of all the cattle in the United States, 42 percent of the milk cows, 65 percent of the hogs, 21 percent of the sheep, and excluding broilers, 34 percent of all chickens. Of the total feed units consumed by these animals 40 percent comes from forages, including pasture, hay, silage and other roughage. Pasturage alone furnishes 25 percent of the animal feed unit requirements.

Soil erosion is still a very real and common problem on sloping lands that have little or no cover. The use of close growing, high yielding forages for erosion control makes soil conservation an opportunity instead of a problem. However, one of the greatest hazards to increased forage production is that of encouraging expanded forage acreage among farmers who lack the knowledge, skill and experience to effectively utilize the crop. Grassland leadership should assist and encourage farmers to grow, not jump into intensified forage production and usage.

Figure 1. These photographs illustrate the terrific erosive force of a raindrop. On the left a drop of water 5.5 mm. in diameter, after falling approximately 7 feet, is now in contact with the surface of water one-fourth inch deep that covers bare soil. In the center photo the splash particles that fly out are heavily charged with mud. This shows the beginning of puddling—a process that destroys soil structure where cover protection for the soil is not provided. The cavity in the photo on the right is symbolic of three forms of damage: a. splashed soil will be transported down the slope by runoff, b. sandy soils suffer heavy fertility losses and only coarse grains of sand are left, and c. clay soils are puddled.

Naval Research Laboratory Photos by V. C. Robey

Soil Conservation and Forage Potentials

It is true that idle grassland has value in soil protection and organic matter renewal, but the value of forages as a feed for livestock will largely determine the extent of their culture on farms throughout the country. Table 2 shows the actual and potential contribution of forages as feed for the various classes of livestock.

TABLE 2

Actual and Suggested Potential Percent Feed Units from Forage for Different Livestock Classes.

Livestock Class	*Percent Feed Units from Forage*		
	United States[1]	*N.C. States*[1, 2]	*Suggested Potential*
Beef cattle	83.1	62	90
Dairy cattle	73.3	72	90
Sheep	92.7	89	95
Hogs	4.7	4	30
Poultry	2.2	4	20[3]

[1] From personal communications with Earl F. Hodges, Agricultural Research Service, U. S. Dept. of Agr. [2] Includes the States of Missouri, Illinois, Indiana, Ohio, Iowa, Minnesota, Wisconsin, and Michigan. [3] Pullets.

Beef Cattle The fact that the North Central States are below the national average in forage utilization with beef cattle is largely due to the emphasis there on corn in dry-lot feeding of market cattle. With emphasis on the use of quality productive pasturage through the growing season it is possible to produce a 900 to 1,000 pound good to choice grade animal with as little as 20 bushels of ground ear corn. Meat produced by these pasture-fed animals is the kind the majority of consumers demand, yet the prevailing practice is that of feeding 40 to 50 bushels of grain per animal in dry-lot. From the viewpoint of soil conservation, particularly on erosive soils, the practice of using the maximum amount of quality productive pasturage is surely to be desired.

Table 3 shows that a low to moderate daily winter gain on feeder calves results in greater use of good pasturage and increased summer weight gains on beef cattle.

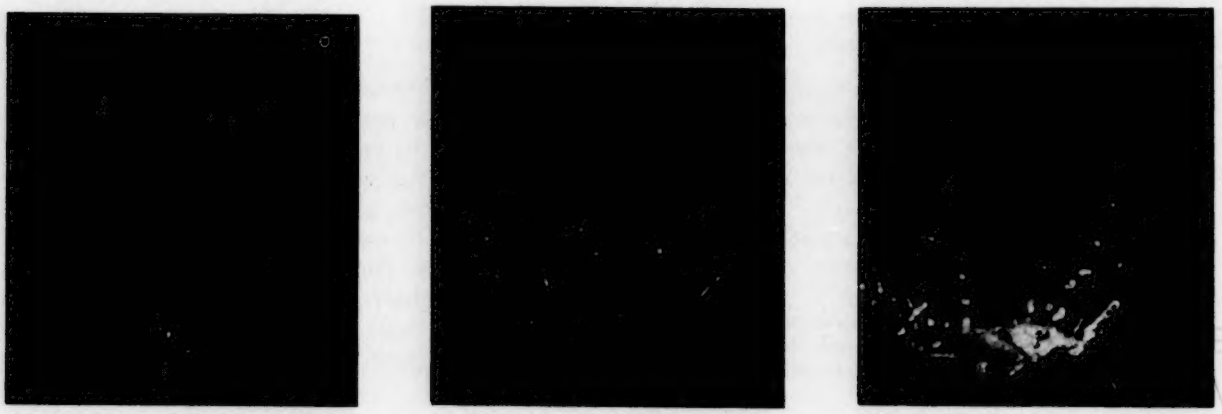


TABLE 3

Influence of Winter Weight Gains on Beef Produced per Acre from Alfalfa Grass Pasture—1953-1956 Average (11).

Winter Gain Pounds per Day	*Pasture Gain Pounds per Day*	*Pounds of Beef per Acre from Pasture*
0.5	1.21	390
1.0	1.08	332
1.5	.83	247
2.0	.66	195

The beef cow herd is well adapted to utilizing great quantities of low quality forage which would otherwise be wasted. The high quality forages should be used by the "bread and butter" animals (feeder calves, feeder cattle and purebred breeding stock). With emphasized forage usage for beef cattle feeding, especially in the Cornbelt, the national potential level of 90 percent of the feed units obtained from forage could be reached for beef cattle. This would result in greatly increased soil conservation intensification.

Dairy Cattle Nearly 73 percent of the feed units consumed by dairy cattle in the United States comes from forage, the balance is provided by concentrates including grains. The grain-milk ratio[1] for the Indiana Dairy Herd Improvement Association herds is 1 to 3.5; nationally, in 39,985 herds it averages 1 to 3.3. With improved forage practices this grain-milk ratio could easily be increased to 1 to 6 or 8.

Experiments with some cows have demonstrated that excellent milk production can be obtained on a high quality, all-forage ration. In New Zealand, high milk production is commonly achieved on all-forage dairy rations; this gives an indication of the forage-dairy potential in the North Central States and its relationship to better soil conservation practices. Several years ago the United States Department of Agriculture summarized many dairy experiments and records and found that in general a dairy cow could produce about two-thirds her maximum milk production on a high forage ration at half the cost of maximum production with concentrate feeding.

Sheep Sheep are extremely efficient in the utilization of forage with over 92 percent of their feed units coming from this source. The forage-livestock management principles are similar to those for beef cattle as regards high and low quality forage usage. The lactating ewe and the market lamb program can easily be fitted to the lush growth of forage in the spring. After weaning the ewe is well suited to utilizing low quality forage until the breeding season begins.

Hogs Today, less than 5 percent of the feed units for hogs are derived from forage. If quality forage was emphasized in swine production it could contribute as much as 25 to 30 percent of the total feed units required. How can hog production be compatible with conservation of the soil in the Cornbelt? The recently initiated forage-swine-land use experiment by the U. S. Department of Agriculture and the Agricultural Experiment Station at LaCrosse, Wisconsin, is classic, I believe, and one of the first of its kind in the Midwest.

[1] Pounds of grain fed to a dairy animal in relationship to pounds of milk produced.

SCS Photo

Figure 2. The fibrous root system of meadow fescue not only binds the easily erodable topsoil together, but its root system helps the soil absorb tremendous quantities of water and when plowed under will supply large amounts of organic matter.

Forages can be best used in hog production as high quality pasturage with limited grain feeding through the growing season. McCormick produced normal rates of gain using 30 percent alfalfa in the growing ration (10). With special management practices he achieved acceptable utilization with as much as 50 percent alfalfa in the ration but daily gains were reduced. Good pasturage for brood sows may save as much as 50 percent of the concentrates normally included in the ration (1). Feeder pig production on pasturage provides a good outlet for quality forage.

Poultry With the ever increasing specialization in the poultry industry the trend has been toward confinement production. However, there is an opportunity for the rearing of pullets on a quality forage range and this

would result in a substantial saving of concentrates. It has been demonstrated by the Ohio Agricultural Experiment Station that pullets reared on Ladino clover range, using an all grain mash and minerals with limited feeding, performed equally as well as layers that received supplemental protein (7). An acre will support 400 to 500 birds when good management practices are used. Geese are the best of all poultry foragers and can be raised and kept on good forage with practically no supplemental grain feeding.

Complementary Benefits from Forages

Several complementary benefits are derived from forages in addition to their nutritive value for animal production.

Soil Production and Stabilization In addition to dissipation of raindrop energy, forage yields prior to corn culture are highly correlated with soil loss the first two months after corn planting. A summary of runoff measurements on Marshall, Shelby, and Fayette soils showed that a meadow which would yield 3 to 4 tons gave nearly 100 percent protection against soil loss during the first two months it was planted to corn. A meadow that would yield 1 ton or less lost 35 to 45 percent as much soil as was lost from fallow ground.[2]

Soil Fertility The soil-plant-animal cycle is enhanced when maximum use is made of highly productive quality pasturage.

It has been observed that 900 animal grazing days per acre will give nearly 100 percent area coverage equivalent of animal faeces and urine (9). Thus, two years would be required for complete coverage in a brome-alfalfa pasture stocked at the rate of 3 animals per acre for a 150 day grazing season. Much of the voided potash and nitrogen may be recycled several times in forage growth during this period.

With emphasis on pasturage the plant nutrient losses are minimized and high levels of available nitrogen can be achieved for row crop production. When alfalfa-grass is used as pasturage little is gained in nitrogen accumulation beyond a 2 year meadow interval (200 to 350 pounds per acre) (17). In any circumstance it is important that the legume-grass combination be plowed down while still highly productive in order to achieve high level row crop yields. The decomposition of the fibrous grass roots with a narrow carbon-nitrogen ratio and subsequent release of nitrogen has been observed to parallel the nitrogen growth curve requirement of the corn plant. Nitrogen saturated grass roots give up nitrogen while "sod-bound" grass roots compete for nitrogen in the decomposition process.

Soil Drainage Grass roots literally permeate the soil profile; the bulk of the roots are found in the upper 12 inches of soil. For example, bluegrass root measurements have run from a little over a ton per acre on a dry weight basis to as much as 4 tons depending on location and management (15). It is along the root channels of both the legumes and grasses that the free water in a soil can more easily percolate to the tile lines and subsoil. A study at the Illinois Dixon Springs Experiment Station showed that before the development of grass-legume roots a poorly drained soil absorbed 2.07 inches of water in 24 hours and was wet to a depth of 11 inches. Following a sod crop 6.68 inches of water were absorbed to a soil depth of 30 inches in 6 hours (16).

Special Forage Uses

Roadside Rights-of-Way Several years ago the Iowa State Highway Commission started a vegetative program on the state and federal roads in Iowa. Mowable slopes were constructed, soil treatments made and adapted grass-legumes mixtures established. In addition to highway protection and a great saving in maintenance costs, farmers were allowed to harvest the forage as hay. Right-of-way areas exclusive of roadbed along all county and state roads in Iowa are estimated to be more than one-half million acres. Here again the engineer is putting the forage resources to work in a very special way and soil conservation is the result.

Gully Control Progress has been made in the Midwest in converting gullies to grassed waterways for use as pasture or harvested forage. This is being accomplished through the use of better adapted species and more efficient conversion techniques.

Improved Pond Water Quality The use of dense, close-growing adapted forages to protect watershed areas of farm ponds and city reservoirs is a recognized practice for producing quality water for domestic use. The water treatment system efficiency is greatly increased where turbidity is minimized by forage production.

Other Uses Adapted grasses or grass-legume combinations are being established in fence rows to control weeds as well as being used on river and stream over-flow lands and waste areas.

Forage Intensification Trends

● In the Cornbelt proper there appears to be a trend toward continuous row-cropping on the level lands and a longer meadow crop interval on the rolling lands. With this development the oats acreage will continue to decrease and alfalfa-grass acreage to increase. In fact, the alfalfa acreage in the North Central States recently surpassed that of red clover; in 1959, there were 11,199,000 acres of alfalfa and alfalfa-grass mixtures (43 percent of the total U. S. acreage in alfalfa) and 6,692,000 acres of red clover and red clover-grass mixture (48 percent of the total U. S. acreage of red clover).

[2] Unpublished national summary of runoff and soil data by Walter H. Wischmeier, et al. 1958. U.S. Dept. of Agr. and Indiana Agricultural Experiment Station.

● Greater use is being made of alternate grazing methods and heavier stocking rates on rotation pastures. Dairymen are becoming more forage-quality conscious. There is continued interest in green chopping as related to forage intensification.

● Commercial nitrogen is becoming more readily available to farmers. Opportunities are increasing for the use of commercial nitrogen on forage stands that are predominantly grass. For example, in southern Indiana, as a 2-year average, 75 pounds of nitrogen applied to orchardgrass increased beef gain 103 pounds, and 150 pounds of nitrogen per acre produced 145 pounds more beef per acre than did the check pasture to which no nitrogen was applied. On a tall fescue pasture the application of 75 pounds of nitrogen per acre yielded an increase of 71 pounds of beef while a 150 pound application of nitrogen per acre resulted in 132 pounds more beef produced on an acre (12).

● Greater specialization and more supervision in the production and distribution of improved varieties of seeds and plants and new species of grasses and legumes make possible the use of improved forage plant materials for specific areas and purposes.

● The development of band seeding and use of the press wheel on highly leached gray soils is a breakthrough of the first order in reducing forage stand establishment risks. Thus, we are moving closer to the goal of precision seeding of forages, which is a given number of live pure seeds per unit area of land to achieve a required population of forage plants.

● The bale ejector and the small bale have taken much of the hand labor out of hay handling. Some farmers use the round bale and leave it in the field for winter feed. One goal of the grassland farmer is to obtain storable forage that will flow and handle like grain. Much developmental work is going on with the portable wafer and pelleting machines.

● A whole array of recent feeding system developments have made the pitchfork obsolete. A few examples are the self-feeding forage wagon, augers, conveyors, self-feeding gates, fence line bunks for self-unloading wagons and the development of pushbutton and time clock feeding controls.

● Because of the rain damage to hay in the spring of the year, in principle, grass silage provides one of the greatest storage potentials for preserving lush spring growth. The use of plastic has recently opened up possibilities for temporary forage storage. The hay cage used in conjunction with the hay buck shows promise of increasing efficiency in harvesting long hay. Haylage is a new and promising innovation of forage storage.

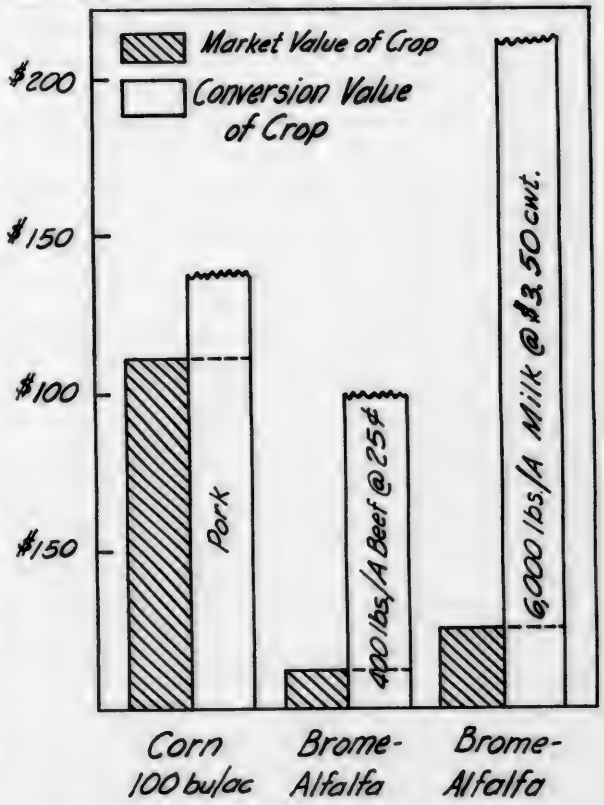
● New laboratory techniques may soon be available to measure more readily the nutritive value of a forage. This will speed up research as well as make possible a forage testing service so that precision forage supplementation for the various classes of livestock can be achieved by the farmer.

● In the North Central States it is now possible in late May and early June to predict with 90 percent accuracy a favorable 3-day haying period. In late June and early July the forecast accuracy is better than 95 percent.

What is Forage Worth?

The total value of the forage crop must be a summation of each forage benefit on a farm or ranch. Thus, forage conversion value (figure 3) + fertilizer value + soil drainage value + soil conservation value + other benefit values = total forage value. The facts for determining the precise value of a single forage benefit are not always readily available. However, as more is learned through research and practice the total forage value can more accurately be determined. For example, corn has a market value which is very high in relationship to a very low market value for forage (figure 3), and for all practical purposes there is a very small or non-existent cash market for forage. However, there is a very low conversion value for corn, but a very high potential conversion value for forage in relation to their market value.

Figure 3. A graphic concept of the market and conversion values of forage compared to corn. The market value of corn is the established market price, influenced strongly by government price supports, while the market value of brome-alfalfa pasture is the local rental price of a very limited acreage.



In southern Michigan, cropland in forage ranges from 20 to 75 percent on individual farm units. Hoglund (6) found that with improved forage management on dairy farms on level land, the highest net income resulted when 40 percent of the cropland was in alfalfa-brome and 40 percent in corn, a ratio of 1 to 1 of sod crops to row crops. With average management on level land, maximum net income was obtained with 30 percent of the cropland in alfalfa-brome and 55 percent in corn, a ratio of nearly 1 to 2 of sod crops to corn. On dairy farms on rolling land having a lower corn yield level but having superior management, the greatest net return was achieved with 60 percent of the cropland in forages, a ratio of 3 to 1 of sod crops to corn. Under average management on these dairy farms on rolling land the highest net income resulted when 50 percent of the cropland was in forages, a ratio of 2 to 1 of sod crops to corn.

Forage Problems

- With any crop there are problems and forages are no exception. Unquestionably the bloat problem in ruminants creates one of the greatest deterrents to forage use, particularly where there is a predominance of the clovers and alfalfa in pasturage. Much team research on bloat is now being done. In some management schemes vegetable oils have been found to be a bloat preventative. Where bloat is critical a preponderance of grass in the mixture is to be encouraged.
- Losses during harvesting of hay and silage are sometimes staggering. Here, trained professional leadership applying the best research results and the practical experience of the farm operator along with the aid of farm machinery engineers, can work toward greatly reducing these losses.
- Government incentive programs which stress grain production and minimize or disregard forages lead farmers away rather than toward greater animal-forage intensification and improved land use.
- There is a gross lack of census data to show the animal product per acre from forage. The *Soil Conservation Society of America* is to be commended for their current efforts and cooperation in this important area of need. In 1950 the value of feed from all grasslands in the United States was calculated by Sprague (14) to be equal to half the farm value of the combined total of 72 principal crops harvested by man in this country. It has been further estimated that the combined value of products from grasslands is more than that of all harvested grains, $7.5 billion compared to $6.5 billion. The census data have never shown information on production from grasslands utilized directly by grazing animals.

Summary

1 Outside of the forested land, productive forages (adapted grass-legume combinations) are the most efficient of engineering materials for dissipating raindrop energy and preventing soils from eroding.

2 Forages must be profitable crops if they are to be generally used by farmers to conserve and improve the soil.

3 Before forages have any commercial value and profitability on a wide scale they must be converted by the animal to products for human use.

4 Productive forages have a very low or non-existent market value in comparison to a grain crop, but in comparison to corn they have a very high potential conversion value in terms of animal products.

5 The professional conservation engineer and the conservation practitioner have a great opportunity to place animals in a soil conservation relationship to the land through optimum forage use when fabricating and establishing conservation practices on the land.

REFERENCES CITED

1. Barnhart, C. E. 1955-1958. *Winter pasture versus drylot for bred sows.* Kentucky Livestock Field Day Reports. University of Kentucky, Lexington.
2. Ellison, W. D. 1949. *Protecting the land against the raindrops blast.* Sci. Monthly 68:241-251.
3. Haynes, J. L. 1940. *Ground rainfall under vegetative canopy of crops.* Agron. Jour. 32:176-184.
4. Hathaway, M., and R. M. Leverton. 1959. *Phosphorus and calcium.* Yearbook. U.S. Dept. of Agr., Washington, D. C.
5. Hays, O. E., et al. 1949. *Investigations in erosion control and the reclamation of eroded land at the Upper Mississippi Valley conservation experiment station.* Tech. Bul. 973. U.S. Dept. of Agr., Washington, D. C.
6. Hoglund, C. R. 1960. *Economic aspects of grassland farming as influenced by improved techniques.* Proc. 8th Int. Grassland Congress.
7. Kennard, D. C. 1951. *Forages. Forage for poultry* pp. 683-690. Iowa State University Press, Ames.
8. Law, J. O. 1941. *Measurements of the fall-velocity of water drops and raindrops.* Part III—Section on Hydrology, Trans. Am. Geophysical U. National Research Council, Washington, D. C.
9. MacLusky, D. S. 1960. *Some estimates of the areas of pasture fouled by the excreta of dairy cows.* Jour. British Grassland Soc. 15:181-188.
10. McCormick, J. A., and J. F. Kidwell. 1953. *Experiments in feeding hogs alfalfa in Nevada.* Cir. 2. Nevada Agr. Expt. Sta., Reno.
11. McVey, W. M., et al. 1960. *Beef production from alfalfa-grass pastures when grazed by steers wintered at four levels of nutrition.* Mimeo AY-147. Indiana Agr. Expt. Sta., Lafayette.
12. Peterson, R. C., et al. 1960. *A comparison of tall fescue and orchardgrass for grazing in southern Indiana.* Mimeo AY-151. Indiana Agr. Expt. Sta., West Lafayette.
13. Salter, R. M. 1952. *Conservation and improvement of soil and water resources with grass.* Proc. 6th Int. Grassland Congress.
14. Sprague, H. B. 1959. *The importance of grasslands in our national life.* Proc. Am. Grasslands Council. Am. Grasslands Council, Norwich, N. Y.
15. Troughton, Arthur. *The underground organs of herbage grasses.* Bul. 44. Bureau of Pastures and Field Crops, Hurley, Berkshire, England.
16. Van Doren, C. A., and L. E. Gard. 1956. *Protecting your soil.* Cir. 667. Illinois Agr. Expt. Sta., Urbana.
17. Willard, C. J. 1959. *Rotation experiments—Paulding, Henry and Madison counties.* Res. Bul. 847. Ohio Agr. Expt. Sta., Columbus.
18. Wischmeier, W. H., and D. D. Smith. 1958. *Rainfall energy and its relationship to soil loss.* Trans. Am. Geophysical U. National Research Council, Washington, D. C.

Effective Use of Water in Agricultural Areas

G. M. BROWNING

Water is vital—for plants—for animals—for man. Next to the air we breathe, water is our most important resource. It is the common denominator of all people in the United States and of their enterprises—agricultural, industrial, municipal, and recreational. Many rural and urban water problems trace back to the land, to the local watershed where rain or snow falls.

UNTIL RECENTLY, people in the humid part of the United States have taken their water supplies for granted, along with air and sunlight, as unlimited gifts of Nature. Far less attention and effort have been devoted to provision for water than to production of food and fiber. Yet, people can survive for weeks without food and fiber, but for only a few days without water.

The demands on available water supplies continue to increase. Each year there are more people to use water, and water consumption per capita is increasing twice as rapidly as the rate of population growth. Total water use in the United States quadrupled from 1900 to 1950. It has been estimated that by 1980 the Nation will be using twice the amount of water it needed in 1954 and triple that amount by the year 2000.

Nearly every community has a water problem—water shortage, water surplus in the form of floods, polluted water, low quality water, or some combination of these situations. Of greatest concern has been the loss of life and property from floods which are the result of temporary water surpluses. However, in recent years, moisture deficiencies and the growing demand on limited water supplies have gradually caused people to realize that water can be a scarce resource and that steps must be taken to determine the rights of control, privileges of use and means for more effective utilization.

Many studies have been made by commissions, committees and others of the overall water problem in the United States. On the average there is enough water, but the crux of the problem of effective water utilization is that it is not always distributed at the right places at the right time. Since man cannot presently change the amount, intensity or distribution of rain and snowfall, the job is to adopt measures and practices that minimize the detrimental and enhance the beneficial effects of water for all segments of society.

This article by George M. Browning is a slightly revised version of a paper given by the author at the National Water Research Symposium on March 29, 1961. This symposium was held in Washington, D. C., March 28-30, 1961, and was sponsored jointly by the National Association of Soil Conservation Districts and the National Reclamation Association.

Mr. Browning is associate director of the Iowa Agricultural Experiment Station, Ames, Iowa.

Watersheds

The watershed is a key unit in a program for effective water utilization. Farmers in a western Iowa watershed boast that every drop of rainfall last spring "stayed right where it fell." The year 1960 was the toughest test of land treatment and structural control practices in the history of that State's watershed program. There was a tremendous accumulation of snow during the first few months of 1960 and this was followed by downpours of rain that challenged every terrace, dam and waterway. When one compares what happened to water in rolling areas where no control practices were being followed, the statement by the Iowa farmers has its merits.

In many an unmanaged watershed there was excessive runoff and a loss of uncounted tons of soil as the tremendous volume of rain last spring raged down the slopes. Watershed programs are authorized on a flood control basis, but flood control is actually a by-product, the result of soil and water conservation practices applied on individual farms in the watershed.

The major objective of a soil and water conservation program is to save topsoil and conserve water for maximum use. It has been repeatedly demonstrated that dams and other water control structures are an essential part of such programs. But structures alone won't do the whole job. Land treatment measures are also a vital part of a complete water utilization program. Practices such as contouring, terracing, cropping systems, and tillage methods not only tie down the soil but also help to control runoff and thus contribute to flood control. Anything that can be done to reduce the force of the falling raindrop before it hits the soil or slow down the water and make it soak into the ground helps conserve both soil and water.

There are other benefits of the watershed approach in addition to the primary ones of saving topsoil, preventing land destruction through erosion, conserving moisture

and reducing the downstream flooding of farmland. Among these added benefits are reduced flood damage to cities and towns, with the consequent saving of lives and property; reduced damage to bridges, roads, culverts and railroads; and reduced livestock losses. Valuable side benefits of water management on watersheds include increased wildlife preservation and reduced damage to wildlife habitat. Another is that ponds and lakes created by the program make prime recreational areas and in some cases these bodies of water supplement municipal water supplies.

Rainfall

In the humid agricultural regions most areas receive 30 to 45 inches of rain and snowfall annually, limited areas receive as little as 25 inches and a few places get 50 or more inches. Compared with the arid West, this is a lot of water. The problem is that distribution does not coincide with needs.

Rainfall distribution varies widely in different parts of the humid agricultural region. On the average, about 50 percent occurs in April, May, and June. At this time of the year the soil is usually moist and has limited storage capacity for additional water. Some land is being prepared for row crops during this period or the plants are small and provide minimum protection to the soil surface. The hard-driving rains on unprotected soil soon seals the surface to further water intake. Because the crops are small they require little water. The net effect is that on uncontrolled areas, much of the water is lost as runoff.

The spring period of surplus water is followed within a few weeks by the hot, low-rainfall summer months. Water use by plants exceeds rainfall, and moisture reserves in the soil are soon greatly reduced by evaporation from the soil surface and by transpiration of the rapidly growing crops. Every year in many areas of the humid region, crop production is limited by too little water. In local areas, production may be cut one-third or more because of a lack of enough water at the time when it is needed. In other areas, local downpours result in excessive runoff and cause damage. It is not uncommon to find experiences of too much as well as too little water on a particular site on a single farm in the same year.

Improved technology, such as higher planting rates, better yielding varieties and more fertilizer have increased water requirements until today water often is the factor that limits crop yields. This explains the increased interest in supplementary irrigation.

Supplemental Irrigation

The problem of supplemental irrigation in the humid region is largely one of economics and of deciding where, when, and if this is the best use of water resources for all segments of society. Some of the questions that need to be answered include:

1. On an average of several years, how much will yields of different crops be increased by extra water and how much water does it take to get these increased yields?
2. Is there a source of quality water available or is it possible to develop a supply?
3. Where and under what conditions is supplemental irrigation economically feasible?
4. What priority does water for irrigation have compared with other uses?

Information from research and field experience with supplemental irrigation is limited in the humid region. Irrigation research and experience in the arid West helps answer some questions. But more information is needed to evaluate the potentials and delineate the limitations, keeping in mind the increasing demand on total water resources.

Vegetative and structural means of controlling surplus water and storing it for future use are vital parts of an effective water utilization program.

Drainage

There are large areas in the humid region where excess water limits potential use of land for agricultural purposes. Tile and ditch drainage have been practiced for centuries. Information from research has made it

SCS Photo by Lathrop

Uncontrolled water not only does irreparable damage to the soil and destroys much property, but loss of the water is a waste of one of man's essential resources.

possible to improve drainage methods, but there is little information on the basic principles of moisture movement through many important soils. Not enough is known about water tolerance of different plants at different stages of development and under different climatic conditions. The most efficient system for removal of excess water is not possible without this information. The urgent need is for fundamental studies to establish the specific effects of the several factors. This requires concentrated efforts in facilities where temperature, humidity and water can be controlled. The basic principles developed in controlled growth chambers must then be checked under field conditions.

Long continued cultivation, soil and crop management practices, and impervious soil layers are but a few of the factors that affect the drainability of soils.

Basic information of this kind is essential to guide the design of new systems or for renovation of existing systems, many of which are now inadequate because of initial faulty design or deterioration.

There still are areas in the humid region that are completely flooded. We need to evaluate the best future uses of these areas to develop plans for their long-time effective use.

The Soil

The soil is a vast reservoir for water storage and it is an important factor in effective water utilization. An average silt-loam soil to a 5 foot depth will hold about 20 inches of water. About 10 inches of this amount is held so tightly by the soil that plants can't use it, neither is it readily lost by evaporation and thus, this is not potential storage space. The other 10 inches of water are available for plant growth.

As plants remove water, there is potential space for water storage. At the end of the crop season it is not uncommon to find that all available water has been used. This is usually the case under legume crops which use large amounts of water. It happens under other crops too, especially in years of below average rainfall. In parts of the region, water from fall and winter precipitation may completely replenish the soil's available water capacity. In other parts of the region, little water is added to the soil during the fall and winter, and this leaves potential water storage space of up to 10 inches. Practices that help increase water intake will reduce runoff and make more water available for crop growth.

In addition to the tightly held water and that available to plants, an average silt-loam soil has space filled with air equivalent to about 10 inches of a 5 foot depth. This is temporary storage space for water. These air space openings or pores are also important because they are the channels through which excess water moves to depths below the normal feeding zone of plants to charge the underground sources which supply wells and streams.

Soils vary widely in their water properties. A sand soil is entirely different from a silt loam or clay soil. There is a need to speed up classification and mapping

of all soils to determine their physical and chemical properties. Land treatments affect these properties. More specific information on these properties is needed before full advantage can be taken of soils as a reservoir for water, for removal of excess water by drainage, for efficient land use adjustment, zoning, tax evaluation or other purposes.

Moisture Inventory

A soil moisture inventory on major soils at different times of the year is needed. Such an inventory has been made in Iowa during the past 5 years at 10 locations on 4 critical dates. At planting time one site had from 1 to 5 inches of available water out of a possible 10 inches. Crops suffered for lack of moisture. At another site, crops suffered from excess water.

On the site where there usually is a lack of moisture during the growing season attempts are being made to improve water utilization. Alfalfa was killed in August to stop water loss by transpiration. Leaving the residue on the surface decreased evaporation and increaed intake of rain and snowfall. This practice resulted in an additional 2 or 3 inches of available water the following spring. Each extra inch of water increased corn yield by 10 bushels an acre.

This serves only to illustrate one of many possibilities for more effective water utilization. In many cases additional research will be required to provide specific information to point the way.

Runoff

Runoff occurs whenever rainfall or snowmelt fills all surface storage and then exceeds the infiltration or water intake rate of the soil. There is no single value for water lost as runoff. A general annual average for the humid and subhumid regions may be about 1 out of 5 inches or 20 percent of total precipitation. It ranges from none for the small storms to more than 100 percent for specific storms on frozen ground when snowmelt is involved.

Infiltration rate of soils varies widely, ranging from essentially none to several inches an hour. Land treatments such as vegetative cover or residues that protect the soil surface from sealing over, or practices such as contouring, strip cropping and terraces that slow down the water and make it soak into the ground will help conserve soil and water. Research at soil and water conservation experiment stations at a few locations have provided information on soil loss and runoff from small plot areas. Runoff data is available from a limited number of small watershed areas. Streamgaging has been done on a few larger watersheds. Measurements have been made of silt load in streams at a few locations. Rates of siltation in reservoirs have also been determined in some areas.

The information from these studies is the basis for today's programs. But in total the information is piecemeal and entirely inadequate for planning a water utilization program to meet future needs.

For example, today, watershed programs are being planned in areas where there is little or no research or field experience. No two watersheds are the same. The soil, slope and vegetative cover vary widely. The land treatment and control structures adequate for one watershed may be under designed for another or over designed for still another. If under designed, costly failures may occur. Over design uses funds that are needed and should be used on other uncontrolled areas. We can't afford this luxury.

To provide the necessary information, control watershed areas should be established in the major soil areas to permit evaluation of the effect of different factors, alone and in various combinations, on runoff and erosion. Recent development of equipment that simulates natural rainfall is an important step forward. This will permit many individual determinations of the effect of different factors and practices on controlled areas within small watersheds. These then can be correlated with runoff from the entire watershed area. It would then be possible to provide basic information about the conditions in a watershed prior to development of plans and on which to base plans.

Contouring, Strip Cropping and Terracing

Contouring, strip cropping and terraces are effective in slowing down runoff so that there is more time for water to soak into the ground. In some areas these practices are used extensively. In other areas acceptance has been slow. On irregular slopes in the humid areas, point rows are common. Modern day four to eight-row equipment does not fit these conditions. This has discouraged many farmers from using regular terraces and has stimulated interest in parallel terraces to eliminate point rows.

More research is needed to answer the many questions relative to the soil and crop management treatments required to bring exposed, less fertile areas back to full production as well as provide facts on costs. Until this information is available, the full potential use of parallel terraces for control of runoff and erosion will not be possible.

Crop Residues

There are many areas where irregular and choppy slopes make contouring or terracing impractical. Erosion and runoff is serious from intertilled crops which are grown frequently on this land. Mulch tillage has been used effectively for controlling water and wind erosion and to reduce evaporation in the semi-arid and arid wheat sections. This practice has had essentially no acceptance for row crop production in the humid region. Wheel track

planting, surface tillage and similar practices have had limited use.

Research is needed to develop machines and management practices that take advantage of the large runoff and erosion control potential possible under row crops. Effective use of crop residues is the only practical runoff and erosion control method on many areas now in row crops.

Tillage Operations

The size of modern machines and number of operations can cause compaction and serious destruction of soil structure. This causes a marked reduction in water intake and increases runoff. The number of tillage operations may be reduced by chemical weed control. Contour surface marks from practices such as furrow openers and listing are used effectively in some areas to trap raindrops where they fall and allow more time for infiltration of water. Use of machines such as the rotary-tiller or sweeps, wheel track planting or some combination of these practices are but a few of the almost unlimited unexplored possibilities for more effective water utilization in the humid regions.

Soil-Water-Plant Relationships

The amount of water used by plants varies widely and is influenced by many factors. No single value can be established for water used, but on the average, 16 to 20 inches annually is not uncommon for many crops in the humid region. Actually, very little is known about the water requirements of different plants; neither do we know how they are affected by wind velocity, temperature and a host of other factors. Until these factors are known, little progress can be made.

Results from recent research indicate that water requirement of plants can be reduced. This will be possible and practical when the basic principles of how plants function are understood. In the humid region there would be little or no loss of yield if the water now required by crops was reduced by 3 to 5 inches. When this is done, and I am sure it will be, it will constitute one of the biggest scientific agricultural break-throughs of our time. The effect on water utilization will be tremendous.

Structural Measures

Control structures are an important part of most watershed programs for storing surplus runoff for future use. More research is needed to determine the efficiency of different structures and to improve upon the design of those which do not stand up as they should or actually fail. The development of basic principles essential in design of structures for different conditions can be done at a single location where adequate controlled water supplies are available. Watershed control programs representing a wide range of conditions afford ample opportunity for field testing these structures to prove they are functional or to indicate the need for further work at the control laboratory.

The importance and value of structural measures have been demonstrated time and time again. Farm ponds are important as a water supply for livestock and other uses. More of them are needed.

Many towns and cities get their water supply from large reservoirs. These or other artificial bodies of water provide recreational opportunity for many people. Systems of dams on major river systems are important for flood control, electric power production, navigation, irrigation and other benefits.

But, as important as structural measures are, they can't take the place of land treatment. Neither can land treatment take the place of structural measures. Each plays an important role. The control possible by combining these practices is limited only by how far we are willing to go in developing and establishing practices needed for specific conditions. Herein lies the opportunity and challenge to more effective water utilization.

Development of Water Resources

Lengthy books have been written on the many phases of water resource development. It is not a question of can it be done but one of how best to do it. Much is already known and much is being done. After looking at future demands and needs, it is clearly evident that much more must be done. It would be impossible here, to explore the many phases of a complete program of water resource development, but in summary a few of the important points of such a program must include:

1 An inventory of the potential source and supply of water, including quality and distribution.

2 Evaluation of present water usage and the determination of the future water needs for all segments of society—agricultural, industrial, municipal, and recreational.

3 Comprehesive studies of the economics of water use and control.

4 Establishment of rights, privileges and priority for water usage, with procedures, regulations, and control to assure compliance.

5 Development of a comprehensive over-all plan that includes effective use of all control measures. This plan should provide for local, state, and national authority and responsibility to help assure an aggressive, adequately financed, unified and coordinated program.

6 Research to assure that essential information is available to plan, develop, and apply the programs necessary to meet the needs.

7 Increased emphasis to acquaint the public with the problem and to stimulate interest and participation to get the job done.

Cost Share Principles Under the Great Plains Conservation Program

T. A. NEUBAUER

THE SHARING OF COSTS by the Federal government to apply a conservation program to the land has come to be accepted by many farmers and ranchers in this country. This kind of financial assistance is available to land operators so they can conserve the all important land resource while using it to make a living. Land operators need help from society on those things they are unable to do for themselves. This sharing of the financial burden is called "conservation cost-sharing."

Such cost-sharing is a part of the long-term conservation idea, known as the Great Plains Conservation Program (Public Law 1021), which was enacted in 1956 by the 84th Congress. The Program provided a means of minimizing the hazards of farming and ranching in the 10 Great Plains States. It supplements existing programs and activities. Its main features include (1) a plan of operations, (2) a contract between the producer and the Government, and (3) cost-sharing on eligible conservation practices. Farmers and ranchers in the designated counties who have control of their land for the contract period are eligible to participate.

Under this program, cost-share payments are provided only as specified in contracts which are prepared for the entire farm or ranch unit. Parts of the needed conservation treatment known as "identifiable units" are the basis for cost sharing under this program. However, this program specifies that conservation problems be solved by bringing together into one plan all needed conservation assistance available from the United States Department of Agriculture for doing the complete job. Contracts run from 3 to 10 years, during which time the practices are to be applied as planned. One of the features of the contract is the provision for payments at established rates to apply the practices.

Needed funds for cost-sharing are obligated by the operator and the Government when the plan is made. This availability of funds assures the application of conservation work as planned. In turn, this assurance enables the farmer to establish schedules by years to carry out the plan. These schedules make possible an orderly installation and spread the need for technical services over a period of time.

The policies for the program were developed by an interagency group in the Department of Agriculture, after which they were taken to the States and counties and placed into operation. Especially emphasized is that plans of operation be prepared based on the established objective—"the use of all the land within its capabilities and treatment in accordance with its needs."

T. A. Neubauer is soil conservationist with the Farm and Ranch Plannning Division of the Soil Conservation Service, Washington, D. C.

Permanent Installations

The permanent or enduring practices emphasized in this program are the ones eligible for federal cost-sharing. This type of limitation in cost-sharing is new in agriculture, and for that reason, its operation and progress can be observed and studied only in the 10 Great Plains States.

The "eligible" conservation practices must be applied "according to the need of the land and the land used within its capability." A list of 24 such soil and water conservation practices have been approved for cost-sharing when carried out in the combinations as developed in the plan of operations. Where one or more States desire to broaden application of the program, practices may be added to this list upon approval by the Secretary of Agriculture.

Annual Recurring Practices

A conservation plan which is an integral part of each Great Plains contract covering the entire farm or ranch unit would necessarily include a complete program designed to protect the land from deterioration and allow it to produce maximum amounts of agricultural products when and as such production is needed. For these reasons, the use of annual and recurring practices are also an essential part of a good conservation plan. They are not considered in addition to the cost-share practices but must be incorporated with the cost-share items.

Since these annual practices are essential to good conservation and can be integrated with those which are cost-shared, most conservation plans will include both types. These annual practices can usually be applied with little additional cost and technical assistance.

Rate Criteria

The regulations controlling the administration of the Great Plains Conservation Program stipulate that the Government's share shall not exceed 80 percent of the cost of applying any one practice. Each State Committee has established rates for the practices applicable in designated counties for the operation of the program. The rates are normally highest for the practices with high

priority objectives—probably at or near the maximum 80 percent rate, while less important practices range down to 50 percent. In this way, it is possible to encourage the application of a balanced program as needed.

The relationship of cost-share rates to the conservation needs in a county or area has top priority. Of special importance are the adjustments needed to accomplish proper land use. The inducements offered to land operators under Public Law 1021 are justifiable in view of the large costs involved and the long periods when returns cannot be expected.

The Great Plains Conservation Program uses the average cost principle at the county level for all practices on which cost-share payments are to be made.

Average costs reflect the actual costs of applying the practices in a county. Each county has different average costs since they are based on the installation cost of any direct or significant factor needed to establish a practice in the county. Such averages would come close to actual costs involved and, at the county level, are the key to a fair cost application of the program.

Once a contract is executed, the approved percentage of cost or rate is a binding obligation and will prevail during the life of the contract. However, average costs, which have a direct bearing on the cost shares earned, may be changed in keeping with normal changes in cost. These costs are reviewed at least once each year. Contracts are not modified to change cost-share rates, since established rates remain unchanged for the life of the contract.

The Great Plains States with counties designated (as of March 31, 1961) for assistance under the Great Plains Conservation Program shown.

Average Costs

Variations in the costs will exist in any particular county and as the average costs are developed, the extremes are discarded. In this way, the costs may be applicable to the largest number of farms in a county. However, since unit costs for large jobs may average less than for small jobs, two different rates for an identifiable unit may be necessary for a county.

Table 1 gives examples of costs of installing permanent type conservation practices as related to the cost-share rate and the cost-share earned by the producers.

Conservation land treatment practices applicable to the Great Plains.

SCS Photos

Effective conservation practices cost-shared under the Great Plains Conservation Program. *SCS Photos*

TABLE 1

Costs on a County Basis in Two States of Installing Various Permanent Conservation Practices, As Related to Established Cost-share Rates.

	County Average Cost	*State Cost Share Rate*	*Cost Share Earned*
	dollars	*percent*	*dollars*
Contour Strip Cropping *(per acre)*			
State A	3.15	80	2.52
State B	5.00	75	3.75
Terracing *(per linear foot)*			
State A	0.04	50	0.02
State B	0.0293	70	0.0205
Brush Control *(per acre)*			
State A	6.00	60	3.60
State B	5.50	50	2.75

Under Public Law 1021, a percentage of the average cost is used as the basis for the cost-sharing program on a county-by-county basis. It is more realistic than the dollar allowance on a state-wide basis for many practices currently used.

Identifiable units, which are parts of a conservation practice, are the smallest subdivisions of a practice for which cost-share payments may be made. Examples of identifiable units for three eligible practices are as follows:

Range Reseeding

1. Seed and seeding (*pounds and acres*)
2. Weed control, two years (*acres*)

Established Permanent Vegetative Cover

1. Seedbed preparation (*acres*)
2. Seed and seeding (*pounds and acres*)
3. Fencing (*rods*)

Constructing Livestock Ponds

1. Earth moving (*cubic yards*)
2. Fencing (*rods*)

No Land Rental

Public Law 1021 provides that the financial resources which are set aside must be used to obtain permanent conservation practices on the land. These installations are a capital investment which adds to the real value of the farm or ranch unit. This program is applicable to land remaining under the control of the producer through a long term contract. The Government does not provide dollar rentals for the use of land under this program. Also, a producer cannot contract the *same* practice for cost-sharing under more than one program.

Progress

The first contracts were prepared in the late fall of 1957 and by June 30, 1960, nearly 5,000 contracts covering more than 13 million acres in 352 counties were authorized for operation in the 10 Great Plains States. More than 3,000 unserviced applications for assistance were on hand on that date.

Among the main features of the Great Plains Conservation Program are the permanent land use adjustments and the reseeding of range land. As of June 30, 1960:

- More than 380,000 acres of cropland had been planned for retirement to other land uses. Nearly 200,000 of these acres were not suited to continuous cropping. These land use adjustments have now been applied on 90,000 acres.
- About 475,000 acres have been planned for range reseeding and 230,000 acres have been reseeded.

This program provides a more complete means to stimulate the application of farm conservation plans already made but not yet carried out. Since Public Law 1021 provides fair and equitable cost-sharing features, this program also speeds up the planning and application effort of the soil and water conservation program in the Great Plains area.

The fixed amounts of obligated funds which aid and make possible the carrying out of conservation practices according to schedule is an important feature of Great Plains Conservation Program. With all necessary cost-share funds either obligated or in hand, the farmer or rancher may apply the conservation program as he desires and as scheduled for application in his contract.

A City Manages Its Forested Watershed Lands

WALTER C. SUSHKO AND IRVIN G. REIGNER

Adequate high-quality water yield, effective timber utilization, recreation, and some research to help orient management are multiple uses developed by the City of Baltimore in its watershed management program.

THE CITY OWNS 17,300 acres of watershed lands. This places Baltimore—sixth largest U. S. city with nearly a million inhabitants—among the larger municipal forest landowners in the East. These watershed lands surround Baltimore's three water-supply reservoirs: Loch Raven, Prettyboy, and Liberty. All three are located north and northwest of the city in Maryland's Piedmont region. The most distant reservoir, Prettyboy, lies some 25 miles from the city limits (figure 1).

Baltimore's first water-supply reservoir was Lake Roland, built in 1862 just north of the city. For years, the main concern of the watershed managers was the loss of reservoir capacity by sedimentation. Dredging was almost continuous until 1916, when Lake Roland was abandoned.

The Loch Raven reservoir was built in 1881 and rebuilt in 1912. Ten years later the dam was raised even higher (figure 2). Since then, two more reservoirs have been added to Baltimore's water-supply system. Completion of Prettyboy Dam in 1933 created another large reservoir upstream from Loch Raven. Liberty Dam, on the Patapsco River, was finished in 1955.

Sedimentation has continued to be a problem. The original Loch Raven Reservoir lost 85 percent of its capacity within 20 years of completion, even though 500,000 cubic yards of silt had been dredged from it during that time (2).

Capacity losses due to sedimentation have been less spectacular in the newer reservoirs because these reservoirs are much larger. Even if the amounts of sediment had remained the same, the capacity of the Loch Raven Reservoir has been increased over 50 times so that sedimentation would have proceeded proportionally at a much slower rate.

Considerable effort has been made to reduce the rate of sedimentation. For many years, the sole purpose of the forests on city-owned watershed lands was to prevent

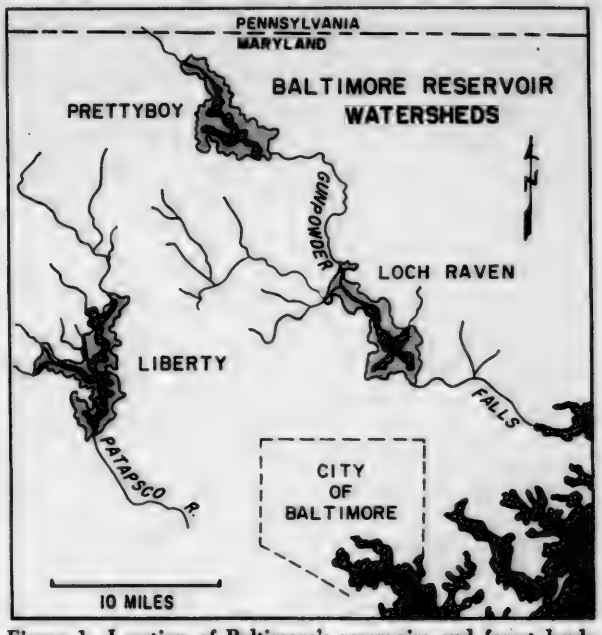


Figure 1. Location of Baltimore's reservoirs and forest lands.

erosion. Neither timber cutting nor any other use of watershed lands was permitted. Forest-management practices were limited to fire protection and to planting of non-forest lands to prevent surface runoff and erosion. Under this planting program, 727 acres were planted on Loch Raven and Prettyboy watersheds prior to 1940. During this period, no consideration was given to the idea of growing and harvesting timber crops.

During recent years, this concept of watershed management has undergone important changes. Director of Public Works, Bernard L. Werner, recognized additional values in forested watershed lands. He saw that along with reservoir protection, the sale of forest products might yield considerable revenue to the city and with careful management, no reduction in water quality need occur.

To bring about a change in program, a Watershed Control Division was created in 1954, headed by Louis G. Ningard from the Water Supply Bureau. The objective of this division as stated in the 1958 annual report was:

> . . . to plan, manage, and supervise a coordinated conservation program of forest, soil, and water, which is based on the principle of multiple use of 17,300 acres of watershed lands for water production and protection, timber-growing, improvement and utilization of timber resources, and recreation. In

Walter C. Sushko is the forester for the Water Supply Bureau of the City of Baltimore, Maryland. Irvin G. Reigner is a research forester, U.S. Forest Service. His headquarters are at the New Lisbon, New Jersey, Research Center of the Northeastern Forest Experiment Station.

Figure 2. Looking across Loch Raven Reservoir at its heavily wooded shoreline.

addition, this Division is responsible for soil erosion prevention, conducts its own sanitation control, and constructs and maintains necessary facilities.

The Watershed Control Division hired a professional forester. This man plans and supervises the forestry program, marks the timber for removal, lays out the forest-road system, supervises logging, and treats the roads and skid trails after logging.

Heavy equipment was purchased, including bulldozers, logging tractors, trucks, and a loading crane. A permanent sawmill was built and a crew of 17 men was assigned to sawmill and logging operations.

The Timber Resource

Through years of protection, the timber on the watershed property acquired considerable value. Mixed hardwoods—yellow poplar, the oaks, hickory, red maple, and beech—comprise the bulk of the forest stands. Virginia pine is abundant, growing in pure stands on abandoned agricultural land and on burned-over areas.

In 1952, the Loch Raven sawtimber stand of trees at least 16 inches diameter at breast height was estimated to contain 15,000,000 board feet. In a 1954 report, the Prettyboy forests were estimated at 8,500,000 board feet. No sawtimber stand data are available for the Liberty Watershed.

On all three watersheds many of the trees in the hardwood sawtimber stands were old and limby and had numerous defects. Taking up considerable space in the stand, they used large amounts of water, yet produced no useful products.

Fire records were not kept before the creation of the Watershed Control Division, but it is known that wild fires were frequent and destructive. Many trees are fire-scarred, and butt rot is common. About 876 acres of Prettyboy Watershed still bear visible signs of fire damage. The Division staff is now trained and equipped for fire-control duties.

The Management Plan in Action

Following creation of the Watershed Control Division, a timber-cutting program was initiated in 1955 on Loch Raven Watershed. Stand improvement is a primary objective; overmature, defective, and low-vigor trees are marked and cut, allowing better development of the more vigorous growing stock.

The entire Loch Raven Watershed has been divided into management units, and these were further split into sub-compartments of uniform forest type. All logging is done by the Division's own labor force, which permits close supervision and compliance with the watershed-protection program.

Almost all the timber cut on the watersheds is sawed at the Division's sawmill, located on Loch Raven Watershed. From November 1, 1955 through June 30, 1959 a total of 6,441,430 board feet of lumber was produced. The city used 5,834,304 board feet. The total value of the lumber produced was $519,853.59.

Forestation

Until 1958, the City of Baltimore had planted 2,299 acres, mostly to loblolly and white pine. The oldest plantings—many dating back to 1912—are on Loch Raven Watershed. About 700 acres of plantings range in age from 26 to 47 years. Present planting is confined to the more recently acquired Liberty Watershed, where about 660 acres have been planted in the last 4 years.

Hardwood sprouts and honeysuckle hinder the growth of young plantations. Methods of controlling hardwoods with herbicides are well known, but research is still continuing on honeysuckle control. Some of this research is being conducted on Loch Raven Watershed in cooperation with the Northeastern Forest Experiment Station and the Maryland Department of Forests and Parks.

Watershed-Protection Program

The key to successful multiple use on watershed lands is a carefully devised plan to protect water values and still permit other activities.

Several safeguards have been incorporated in Baltimore's plans. Preliminary location of permanent forest roads is made by the forester using aerial photographs and topographic maps; the final location is then marked

Figure 3. A regenerated logging road that has been seeded and mulched.

on the ground. All roads are laid out with the lowest possible grades on side-hill slopes away from stream channels. Where roads have to cross streams, culverts are used.

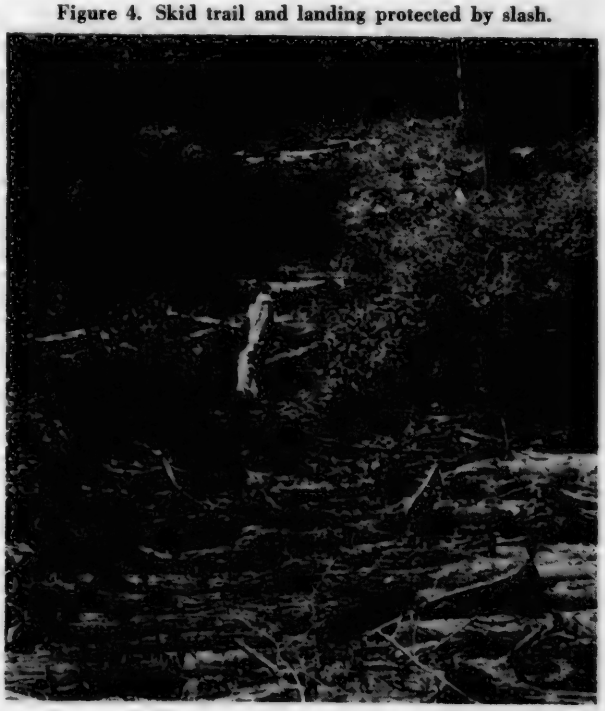
In logging, a certain amount of damage cannot be avoided, especially when crawler tractors are employed; but the damage can be corrected. After logging is completed in a compartment, all permanent roads are regraded, and water bars are installed by making a wide, shallow sweep with a dozer blade. As a supplementary measure, those sections of roads on grades are revegetated. Weeds and grasses, cut on the city's grasslands just before seed-ripening time, are baled and used as a mulch where needed. In this way the road is seeded at the same time it is mulched (figure 3).

Slash is also used as a protective agent (figure 4). It is lopped and placed on old skid trails at such angles as to lead surface runoff out of the trails at frequent intervals and thereby prevent erosion. In contact with mineral soil, the slash decomposes faster, thus reducing fire hazard and improving infiltration in the skid trails. Streams are always cleared of any slash from the logging operation.

A well-designed and well-constructed permanent road system has several economic benefits. Log hauling is faster, and there is much less wear-and-tear on equipment. Being permanent and easy to maintain, roads will be available for future logging. Amortized over a period of several timber cuttings, the cost charged to each logging job is less than if temporary roads had been constructed. Finally, the roads are available for other uses, chiefly for fire control.

Under this program, a total of 15 miles of permanent forest logging roads were constructed from 1955 through 1958 to serve 1,349 acres of Loch Raven Watershed.

Figure 4. Skid trail and landing protected by slash.



Roads are checked annually to make sure the drainage structures are functioning and that they are passable in case of emergency.

Recreation

Public recreation is the third major use provided by the Baltimore watersheds, and it is the most difficult to manage. As on all publicly-owned lands, the demand for outdoor recreational facilities is growing by leaps and bounds. This mushrooming demand is often in conflict with the primary aim of watershed managers: the maintenance of a high-quality water yield. There is only a little background knowledge on the compatibility of the two uses and even less research. Thus, it has generally been the policy of watershed managers everywhere to be cautious in allowing the expansion of recreational facilities.

A regulation adopted in 1919 by the City Bureau of Water Supply prohibited all types of recreation on the reservoirs and city-owned watershed lands. But in 1946 the Bureau entered into a trial contract with a local sportsmen's association to allow controlled fishing and boating on Prettyboy Reservoir. Later these privileges were extended to the other two reservoirs. Over 100 picnic tables are maintained on the three watersheds, but campfires are prohibited. Deer hunting with bow and arrow is permitted on Prettyboy Watershed. A golf course has been built and horseback riding is allowed on Loch Raven Watershed. However, no swimming is permitted on any of the three reservoirs.

Figure 5. A stream gaging station on one of the small research watersheds.

As may be expected, these activities have somewhat damaged watershed lands. Picnickers drove their cars right up to the tables, instead of parking them on the roadsides; so curbs had to be built to prevent damage to the forest floor. Continual use of logging roads as bridle paths has destroyed road surfaces and accelerated erosion. Perhaps the most serious erosion problem occurred in the construction of the golf course; the course itself was vegetated immediately, but the borrow pits were neglected and became a serious source of sediment.

These problems are not particularly difficult to solve, but they point up the need for careful planning and strict supervision in administering watershed recreation. As the primary responsibility of the Bureau of Water Supply is to provide high-quality water, it is necessary that the watershed managers have the authority to maintain proper recreational facilities.

Research

To guide its watershed-management activities, the City of Baltimore is conducting several cooperative research projects, in addition to the honeysuckle study already mentioned. Outplantings of several tree-improvement studies carried on by the Maryland Department of Research and Education are located on Prettyboy Watershed. These outplantings are part of a widespread study on the racial variations of Virginia pine, Austrian pine, and Scotch pine.

In cooperation with the Northeastern Forest Experiment Station, three small sub-watersheds are being studied intensively to determine the effect of vegetation on water yield and distribution. All three areas are equipped with V-notch stream-gaging stations to measure water yield (figure 5). Precipitation, air temperature, and relative humidity are also measured on the watersheds.

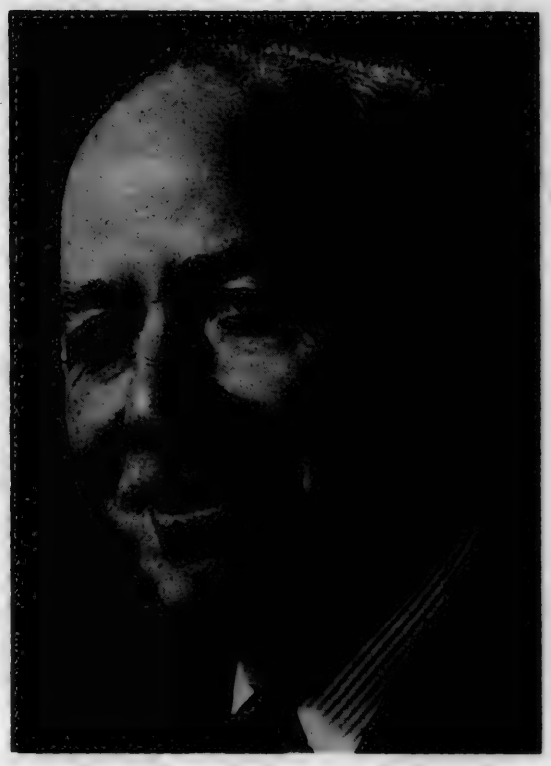
Two of the watersheds were planted to loblolly pine several years ago, and the third watershed is presently forested. After the watersheds are calibrated the vegetation will be treated and the effect on streamflow will be determined.

Results of this research will be used not only to guide the watershed management on reservoir lands but also as a means of evaluating the effects of forest planting and practices on the watershed area above the reservoirs. In carrying out this research as well as its management program, the city hopes to stimulate interest and practice in forest and watershed management throughout the whole of its water-source area.

REFERENCES CITED

1. Brown, Carl B. 1944. *The control of reservoir silting.* Misc. Pub. 521, U.S. Dept. of Agr., Washington, D. C. 166 pp.
2. Gottschalk, L. C. 1944. *Sedimentation in a great harbor.* Soil Conservation. 10: 1-5.

Hugh Hammond Bennett



Hugh Hammond Bennett was a man of the soil. He loved the good earth. His greatest pleasure was to make tracks in a recently plowed field or to ramble through a wooded area.

It is to the memory of this man that the Soil Conservation Society of America will dedicate its permanent home—the international headquarters of the Society.

His Influence on Soil Conservation

T. S. BUIE

THE 80 YEARS, save one, of Dr. Bennett's life may logically be divided into five periods. The first began at his birth on April 15, 1881, and continued until his graduation from college in 1903. It was during this period that "The Chief," as his countless admirers later knew him, developed his strong physical stamina. He labored hard throughout his youth on the home farm on Brown Creek in Anson County, North Carolina. Here, from his father, he gained a knowledge of the land and its need for protection. Later, he laid the foundation for his technical knowledge and skills as he studied chemistry at the University of North Carolina.

T. S. Buie is state conservationist with the Soil Conservation Service and is headquartered in Columbia, South Carolina.

This presentation was made by the author on February 7, 1961, at the Southeastern Section Meeting of the Soil Conservation Society of America, held in conjunction with the 58th Annual Meeting of the Association of Southern Agricultural Workers, Jackson, Mississippi.

The second period of Dr. Bennett's life embraced his first years of service as an employee of the Bureau of Soils in the United States Department of Agriculture. It was during these years, from 1903 to 1911, that he developed the theory, later to be proven fact, that the soil is not indestructible, that it is subject to change by action of the elements, and that these changes—many brought about by mistreatment of the land—can have dire results for mankind.

It was during this period that his labors carried him into many southern States and included the historic work in Louisa County, Virginia. There, in company with W. E. McLendon, his fellow worker and lifetime friend, he noted the effects of removing the surface layer of soil. Further study confirmed the early observations of the young soil scientist, and in 1911 he made his classic report on Fairfield County, South Carolina. His survey indicated that 136,000 acres of formerly cultivated land in Fairfield County were ruined for further productive use, either by gully erosion or by deposits of erosion debris washed from the uplands.

It was during the third period, 1916 to 1929, that Dr. Bennett served so effectively in the Bureau of Soils.

The 22 years from 1929 to 1951 constitute the fourth segment of his life and may be described as the time of action and achievement. In 1929, Congress appropriated $160,000 to investigate the erosion problems of the Nation. Bennett was placed in charge of the major part of this work. At last he was able to study erosion problems on a large scale. At last he could put his ideas to the test.

In 1933, the Soil Erosion Service was established as an emergency agency in the Department of Interior. Bennett was placed in charge as Chief. In 1935, this agency was transferred to the Department of Agriculture and given permanent status. Americans were indeed awakening to their dependence upon the land and began to recognize it as the source of their food, their raiment, and their shelter.

From 1951 to 1960 the revered Dr. Bennett lived in retirement on his beloved Virginia acres. He was near enough to Washington to maintain contact with his many friends, near enough to the center of activities to keep his finger on the pulse of the conservation movement, and yet have the opportunity to live close to the soil he loved. Daily he labored with his own hands in the good earth.

Bennett—a Non-Conformist

Hugh Bennett came upon the scene at an opportune time. During the early years of Bennett's work for the Government, Cyril G. Hopkins, the renowned soil technologist of Illinois, was in his prime. Milton Whitney, head of the Bureau of Chemistry and Soils, likewise was a recognized leader in the field of soil science. Their viewpoints were diametrically opposed; Bennett could subscribe to the theories of neither one. He did not share with Hopkins the belief that rotations and application of appropriate inorganic fertilizers would solve all soil fertility problems. He could not subscribe to the belief of Whitney, his immediate superior, who said, "The soil is the one indestructible, immutable asset that the Nation possesses. It is the one resource that cannot be exhausted."

These men were not at all impressed by the young scientist's concept of soil erosion. Each held fast to his own ideals, failing to see what the young man, who later was to create a new science, perceived and understood as he studied the Nation's soils.

It is of the years from 1929 to 1951 that we have the best knowledge of Dr. Bennett and his activities. This was his period of achievement. It was during these years that he was privileged to see his vision become a reality. That vision was of a robust and virile nation, peopled by individuals themselves strong and vigorous in their own right, able to produce in abundance for themselves and others. The spectre of starvation and want riding hard over a country with its soil depleted, unable to support its people, and its civilization crumbling was the only alternative to this vision. Thus, to Bennett, there was no real choice; he *had* to sound the alarm and waken people to action. It was his indomitable courage and refusal to be swerved from his primary objective which enabled him to make his vision a reality.

Hugh Bennett was an evangelist—a man of the soil—and for decades he traveled throughout the length and breadth of this Nation waving a flaming sword in defense of his ideas concerning land use and treatment. It is because of these activities that he is best known.

Hugh Bennett was one of the world's great soil scientists. His widely publicized evangelistic efforts in behalf of saving the soil so overshadowed all else he did that people frequently overlook the fact that he was a trained soil chemist. His thinking was not that of the usual chemist. His vision extended far beyond the test tube and laboratory. He was the first to recognize the need for molding the various disciplines related to soils and their use into a comprehensive program. This was first done on the original demonstration projects established by the Soil Erosion Service in the mid-thirties.

Bennett realized far better than anyone of his time that the soil was not only a living, changing, dynamic substance, but that it was subject to natural deterioration and acute damage by man's activities. He knew that erosion was not something, such as thunder and lightning, with which one had to live, but that while it was a serious menace, man could do something about it.

Perhaps it was his ability to see the whole, made up as it is of many parts, which was Bennett's greatest contribution to American agriculture. In this connection I am reminded of the exclamation of a distinguished agricultural worker who, 25 years ago, upon seeing for the first time a completely treated landscape on a demonstration project, exclaimed: "Whose idea was it to bring all of these things together into a common program?"

Bennett—with But One Objective

Dr. Bennett was a dynamic character. He had but one objective in life—the wise use of the soil, water, and other natural resources of the country he loved. He cared little for the opinion of others, provided his basic objective was furthered. There were some who misunderstood him; there were others who opposed him; there were a few who violently fought him. But no one ever questioned Hugh Bennett's courage, his adherence to an ideal, and his ability to get things done.

Yes, he had but one objective, and he was not to be deterred from its achievement. That objective was the proper use and treatment of the land. In the demonstration projects of the mid-thirties it was learned that land could be rebuilt, pastures could be improved, crop

And the vision of Hugh Hammond Bennett became reality. Millions of acres of land have been protected against the hazards of erosion, old scars have been healed; new beauty and increased productive ability have been the result. *SCS Photo*

yields and farm income could be increased, and timber and pulpwood could be produced through sound conservation farming. In short, that proper use and care of the land resulted in higher yields and profits.

It was not from a master plan conceived in the Department of Agriculture, nor within the cloistered walls of a university, that Hugh Bennett worked. His concept of a nationwide conservation program demanded that it be assembled field by field, pasture by pasture, woodlot by woodlot, until every single acre of land from the top of the highest mountains to the edge of the sea was protected.

Although Dr. Bennett spent his entire professional life as a federal employee, he never shared the feeling of many that action by the Government is necessary to solve every problem which may arise. In fact, he took the opposite view—people must be led to work out the solution of their problems. He felt from the beginning that farmers, themselves, should take over the soil conservation movement.

Thus, early in the development of the soil and water conservation program, he insisted upon action by local people. While numerous individuals contributed to the concept which found expression in locally organized and directed soil conservation districts, his was one of the principal contributions. After soil conservation districts became a reality, he hailed them as the greatest achievement of modern agriculture. It was his belief that the public should assist, but not dominate, local programs for the conservation and wise use of our land, water, and other natural resources.

Bennett—a Forceful Speaker

No religious evangelist ever spoke with more fervor, more forcefulness, or more sincerity, than did Hugh Bennett when he had an appreciative audience. Never did he fail to captivate those who heard him. His custom was to start by reading a carefully prepared paper and after a few minutes cast it aside and talk extemporaneously. His stock of stories was unlimited. If he noted a slight wavering of the attention of his audience he would tell one. With his listeners again alert he would proceed to drive home with telling effect the point he wanted them to remember. I should add that his enthusiasm often caused him to miss many good stopping points in his speeches.

During the years of the "Chief's" evangelical efforts, he frequently deplored the fact that not a single book on soil erosion or conservation could be found on the shelves of any college library. He was safe in saying this he said, for he knew that none had been written.

Today, a quarter-century later, such is not the case. Literally scores of books on soil and water conservation, suitable for every purpose and need, are now available. Many of these are from Bennett's own pen or the pens of those closely associated with him. His *Soil Conservation*, a work of over 1,000 pages, is a classic.

Bennett's travels carried him to the far parts of the earth. He often said that he had observed and studied the soils of every county, except 3, in the 48 States. Not only did he have intimate knowledge of the soils of the United States, including Alaska, but he studied and advised concerning the best use of soils in Cuba, numerous Central and South American countries, and in many countries in Africa. During later years he visited Italy and other European countries. Men came from the far places of the earth to learn from him. Soil conservation services patterned after that of the United States have been set up in many countries. To virtually every person who had anything at all to do with the soil in any part of the world the name of Hugh Hammond Bennett and the term "soil conservation" were, and are, synonymous.

Honors Upon Honors

It was inevitable—and logical—that honors would be heaped upon this man. Honorary degrees were conferred on him by his own University of North Carolina and by Clemson Agricultural College. He was one of the first recipients of the Distinguished Service Award, the highest honor the United States Department of Agriculture confers upon members of its staff. Professional societies and foreign governments seemingly vied with one another to honor and recognize his accomplishments. But Hugh Bennett was unchanged by public acclaim. He was always more interested in the soil, its people, and in good eating, than in receiving honors.

One of the highlights of Dr. Bennett's full life was the celebration of Hugh Hammond Bennett Day in his native Wadesboro, North Carolina, on September 9, 1946. The Brown Creek Soil Conservation District gave him a "Welcome Home" such as has been given to few native sons anywhere at any time.

The man who had gone forth from this community to bring honor and credit to it, as well as to himself, was greeted by many state and national leaders. To him they paid homage.

Dr. Bennett left his imprint on many groups as well as activities. He was the founder of the *Soil Conservation Society of America*. He made many contributions to the development of this organization in its formative years. Likewise, along with Louis Bromfield and a few others, he participated in and encouraged the founding of the Friends of the Land. This organization, recently combined with the Izaak Walton League, was effective in bringing to city people a greater realization of their dependence upon the land. He gave encouragement and assistance to the organization of the National Association of Soil Conservation Districts. While not taking an active part in this group, his advice was most helpful during the early years.

Love For People

Bennett loved people. To talk with and to others to stimulate their thinking, was one of his greatest joys. Anyone who lived such a full life as he did was bound to have many stories circulated concerning him. While he still lived, his life became legendary. The conversation of any group of his friends is never complete without relating at least a few of these stories. Many of these center around his enjoyment of food and his ability to consume large quantities of it.

Call it showmanship, curiosity, interest, or what you will, but "the Chief" insisted on getting the facts for himself. This he did even when that involved scrambling to the foot of a river bluff in the Mississippi Delta, and wading in shoetop-deep mud to observe deposits of sediment.

It was this quest for knowledge which enabled him to store such a wealth of information upon which he could draw on any occasion. It was this spirit which encouraged and inspired his associates to action. It was this attitude which made him the leader in soil conservation, not only in America, but throughout the world.

During the closing years of his activity he saw his ideal of proper land use and treatment become the avowed objective of the United States Department of Agriculture. On February 15, 1951, Charles F. Brannan, then Secretary of Agriculture, stated officially in Memorandum 1278: "The basic physical objective of soil conservation activities by Departmental agencies shall be the use of each acre of agricultural land within its capabilities and the treatment of each acre of agricultural land in accordance with its needs for protection and improvement." This is one pronouncement which we predict will never be abrogated by any successor for it is too deeply ingrained in the thinking and activities of the American people.

His Spirit Lives

All that is mortal of Hugh Hammond Bennett lies on a grass-covered hillside in Arlington National Cemetery. The only identification is his name, date of birth and date of death, and the words, "Father of Soil Conservation," inscribed on a marble slab.

But the spirit of "the Chief" lives. It lives in the lives of those who knew him—who worked with him—who loved him. It lives in the rural scenes which were so close to his heart—the tree-covered hillside, the verdant pasture, the contour furrow as it winds around the hillside, the clear sparkling stream which flows from a watershed completely protected against erosion hazards.

The spirit of such a man as Hugh Hammond Bennett can never die. His spirit lives and will continue to live in the lives of all who follow in his steps and carry on the conservation and wise management of the soil, which he so loved.

Our National Park Policy—A Critical History. *By* JOHN ISE. *701 pp., illus., index, 1960. The Johns Hopkins Press, Baltimore 18, Maryland. $10.00. (Reviewed by Justice* WILLIAM O. DOUGLAS, *Washington, D. C.)*

This book is a valuable study of our national park system. It is a scholarly attempt to bring up-to-date the conservation struggle in the national park area that has continued now for about a century. The historical facts that it discusses are honestly and reliably stated; the text is bolstered by short but illuminating footnotes that are an arsenal of facts and of law. One shortcoming lies in the failure of the author to consult the files of the Sierra Club. Their rich material is unhappily absent. Yet this is a good reference book that belongs in every library. It is an almanac of liberty in the field of conservation that everyone who is opposed to present-day despoilers will need to help keep fresh in the minds of our people the spiritual values of the few remaining islands of wildness we have left. This book is a product of Resources for the Future, Inc., established in 1952, whose able director, Marion Clawson, has added a Foreword. The author is a distinguished professor from Kansas.

The book opens with the history of the Hot Springs National Reservation, established in 1832, and moves on to the creation in 1872 of our first national park, Yellowstone. Then came Yosemite; and since 1890, twenty-five other national parks. The two treated near the end are the Virgin Islands Park and Petrified Forest National Park. National monuments, also administered by the Park Service, are included and put in their historical as well as their modern setting.

The main part of the book starts with the creation in 1916 of the National Park Service. It then treats the story administration by administration; not president by president, but director by director, starting with Steven Mather and ending with Conrad Wirth. The problems of each administration are discussed—political problems with Congress, bureaucratic controversies with other departments (particularly the Forest Service), battles with lumber, sheep, cattle, and mining interests, struggles with civic and other groups to keep dams from being built that would encroach on wilderness areas. (One of the saddest episodes of this character that is related is the way the incomparable Hetch Hetchy in the Sierra was lost.) Other attempts at desecration and despoilation are included—the proposal to put an elevator alongside the Lower Falls in Yellowstone, the idea of running cable cars over the Grand Canyon to save people from the ugly chore of walking, the suggestion of a cable car to Glacier Point in Yosemite, the pressure to create new falls by building new dams, the propaganda for floodlights on falls, the incessant demand for ski lifts so that the physically unfit can ski without giving up dry martinis or cigars (Conrad Wirth said "If the people can't use the areas, there is no use having them."), the demands for television towers, ferris wheels, aquaplaning, hydroplane racing, religious shrines and religious structures, observation towers, museums, dining rooms, motels, and what-have-you.

Park policies are discussed in some detail—the problems of trailers, predator control, wildlife disease control, hunting in national parks, concessions and concessionaires, park expenditures and park income. Finally there is a section devoted to park wilderness areas as opposed to park development schemes. The book ends with a brief chapter on parks in other nations.

When the book is read line by line, paragraph by paragraph, in an unhurried way, the total impression is pessimistic. The basic Act provides that national parks are "to conserve the scenery and the natural and historic objects and the wildlife therein, and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Many parks have been sorely mutilated. The old scenic road out of Tuolomne Meadows in the Sierra was too slow for speedsters. So the Park Service at tremendous expense cut a highway through one of the loveliest glacial rocks that can be found. Yosemite that John Muir loved so greatly is overrun. Yellowstone is almost a monstrosity. Roads, hotels, and concessions have made some of our parks little Coney Islands. Mather early pleaded for money for roads. The idea was to get people interested in the parks so that they could be maintained against the pressure of the special interests that saw the dollar sign on all their glories. Perhaps that was necessary. In effect it was like the man who takes a bit of heroin only to find that in time he is an addict. Roads and all that go with them have virtually strangled some parks; others have escaped. Perhaps the ideal one is the Smokies where civilization is mostly on the perimeter. But the vision of the park that John Muir saw has mostly gone a-glimmering. A new commercial image has taken its place. The result is a great resistance by those who love wilderness to turn the Allagash (of northern Maine)

into a national park; a park designed on the basis of the Yellowstone would ruin the Allagash.

Not all these ideas are in the book. Yet they—and many more—are provoked by it. It should be read by all who love wilderness if for no other purpose than to get a feel of the plight we are in because of a federal bureaucracy that also puts dollar signs on too many things whose values are wholly spiritual.

Gifford Pinchot—Forester-Politician. *By* M. NELSON MCGEARY. *481 pp., illus., refs., index, 1960. Princeton University Press, Princeton, New Jersey. $8.50. (Reviewed by* WILFRID G. RICHARDS, *Des Moines, Iowa.)*

Professor McGeary had planned to write a political biography of Gifford Pinchot, energetic and determined leader of American conservation, but soon discovered that Pinchot's multitudinous activities and interests were so intertwined that it was impossible to treat him as a politician without also developing his career as a conservationist. Consequently this first biography of Gifford Pinchot is an excellent contribution to the history of the conservation movement. It relates not only his activities but the activities of those who were his associates in the movement, including Theodore Roosevelt, James R. Garfield and Henry S. Graves early in the century and later Franklin D. Roosevelt. Among Pinchot's outstanding contributions to conservation in the earlier period were his insistence that conservation meant wise use of resources rather than hoarding, and his tremendous ability to secure publicity for a cause.

Made financially secure by inheritance, Pinchot decided to devote his life to public service, studied forest management in Europe and became America's first trained forester. Appointed head of the Division of Forestry in the Department of Agriculture in 1898, Pinchot became chief of the newly organized Forest Service in 1905. In the 5 years during which Pinchot remained chief of the Service, he was able to build up one of the strongest agencies of the Federal government, for in addition to his extensive knowledge of forest management he had great ability as an administrator. By example, he established the practice of having administrators at Washington spend as much time in the woods as possible so that they could know the field men and have first hand knowledge of the problems they faced. Even after the "Ballinger affair" led to his dismissal from the Forest Service, Pinchot retained an active interest in it and this resulted in a break with his old friend Harold Ickes in 1937.

In addition to bringing forest management to the uncared for forest reserves of an earlier period, Pinchot was the first to establish control over grazing on public lands, and he also instigated continuing government control over water power sites on Federal property. In this latter situation he began a feud with the public utilities which lasted throughout his two terms as Governor of Pennsylvania.

Gifford Pinchot supported all phases of conservation and many other causes as well for he was unhappy unless in action. Since he tended to oversimplify issues and attempted to force all men to either stand with him or against him he became an extremely controversial figure and was involved in a number of acrimonious debates. A greater ability to distinguish shades of light and dark would have avoided much controversy but might well have made Pinchot a much less effective crusader. Pinchot's political career is also well portrayed in the last half of the volume but throughout life his interest in conservation never lagged. Readers will find the entire biography of this remarkable man well worth perusal for it is interestingly written and covers a span of 50 years during which American conservation made tremendous progress.

Water for New York: A Study in State Administration of Water Resources. *By* ROSCOE C. MARTIN. *264 pp., index, 1960. Syracuse University Press, Box 87, University Station, Syracuse 10, New York. $5.00. (Reviewed by* ROBERT C. OTTE, *Washington, D. C.)*

Water-resource administration in most States has evolved on a piecemeal, ad hoc basis. A problem arises, a study committee is appointed, a law is passed, and responsibility is given to an existing agency or a new agency is created. The result is fragmented responsibility, which makes multiple-purpose development difficult and allows much of the resource potential to fall through the slats. According to Professor Martin, New York is no exception.

Martin traces the historic development of State water policies and of the several agencies that administer these policies. He outlines the present organizational structure, including its interstate and international aspects, and defines the responsibilities of each agency. He then takes four cases to illustrate the operation of State water policies and the actions and interactions of the agencies.

New York City's quest for water and the controversy over building the Cannonsville Reservoir on the Delaware River is one case. The struggle between the Black River Regulating District and the "forever wild" interests is another. Martin takes the Buffalo River as an example of a serious stream-pollution problem and develops its "unappetizing history" and the partially successful attempts at cleanup.

His fourth case is the development of hydroelectric power on the St. Lawrence River. This stream has a

maximum flow record of only a little more than twice its minimum flow. This compares with a flow ratio of 25:1 for the Mississippi and 35:1 for the Columbia. Despite this potential for firm power and no great physical problems, it was not until 1954 that the Power Authority of New York was authorized to develop St. Lawrence power. He describes the public versus private and interagency conflicts plus the international negotiation that culminated in this authorization, as well as the subsequent controversy over allocation of the power.

Martin ends by proposing a procedure for reorganizing the State administration of water resources. He would do this by having New York follow the recent example of a number of other States and create a Water Resources Commission, eschewing ex officio appointments and interest-group representation in favor of "citizens who have demonstrated their interest in public affairs through significant lay (uncompensated) public service." Through a professional staff, the commission would inventory and evaluate the State's water resources, develop overall policy, and make recommendations for legislation regarding water-resource law and administration.

The book is very readable, with dashes of the pungency and humor that is lamentably lacking in much of the writing in this field. This work augments previous studies made in some other States, and it is to be hoped that more students of politics will undertake similar tasks in the remaining States. We badly need better criteria and guidelines to devise the State administrative machinery necessary for rational and effective control, development, and allocation of the water resource.

Politics and Grass: The Administration of Grazing on the Public Domain. *By* PHILLIP O. FOSS. *236 pp., index, 1960. University of Washington Press, Seattle 5, Washington. $4.50. (Reviewed by* THADIS W. BOX, *Logan, Utah.)*

In this book, Mr. Foss gives a brief history of the development of our public domain up to the passage of the Taylor Grazing Act and then uses the Act for an extended case study of the formation of public policy dealing with the western range. The discussions dealing with land disposal policies offer the reader a well organized, historical account of the public domain and set the stage for understanding the feeling that led to the enactment of Federal grazing laws.

The book contains chapters on the acquisition and disposal of the public domain, the passage of the Taylor Grazing Act, the organizations of the Federal Grazing Service, grazing district administration, workings of the advisory boards, and case studies of an Oregon Grazing District. A final chapter is devoted to a historical study of the development of Federal grazing fees. The first three chapters are devoted to establishing a need for Federal control of the public domain and giving an historical account of the political events that led to the enactment of the Taylor Grazing Act in 1934. Chapters four, five, and six deal with the establishment of grazing districts and administration of grazing on the public domain. The first six chapters give a good historical account of the problems involved in obtaining legislation to prevent landless nomads from completely destroying one of the public resources, the western range.

Mr. Foss ably points out the monumental job faced by members of the Federal Grazing Service in establishing administrative policy from a rather general grazing act. In attempting to gain "home rule on the range," the first director of the Grazing Service established a system of advisory boards to recommend administrative procedures. Apparently Mr. Foss feels that some of these boards became rather dictatorial and fell into the hands of only a few men. He states, "We may recapitulate voting participation, tenure of members, and tenure of officials in the advisory board system by noting that the percentage of voting participation is generally very low, the tenure of advisory board members is long—ten years is common, and officials of the boards also tend to have long terms in office. Do these conclusions indicate that the advisory board systems is 'home rule on the range,' or do they suggest the presence of a rural caste system which decentralized administration has hastened and crystallized?"

For his case history of a grazing district, Mr. Foss chose the Soldier Creek Grazing Unit in Oregon's Grazing District Three. This district had a long history of conflicts from its beginning. The advisory board was dominated by one man who was successful in removing both local graziers and district managers from office if they crossed him. Although it is an interesting story of a grazing unit that was plagued from the start by strong board members and weak or poorly qualified administrators, I feel that it is unfortunate that Mr. Foss should pick it as his case study. Although he states, "while the case is not a typical example of grazing district administration because of the frequency of conflict situations, it is by no means unusual or abnormal," he fails to give the reader an example of one of the many grazing units in which the advisory board and the administrator work together in harmony to achieve continuous sustained yield of the valuable forage resource.

There are examples of good management on public range throughout the West, but it is seldom that the reader of current literature is exposed to these. Far too often, writers of periodicals and books select the dramatic, contested cases of conflict for their examples. Such a policy may convince the casual eastern reader that the western rancher is out to ruin a resource. Actually it is

the western rancher who depends upon the public domain for his livelihood and he is not apt to destroy the hand that feeds him.

The chapter "The Grazing Fee Controversy" more nearly fits the book's title, *Politics and Grass,* than do the other chapters. In this chapter, Mr. Foss points out the powers of congressional committees, lobby groups, and other rancher limited sections of the "public" in directing legislation. This chapter, in particular, should command the interest of all who seek legislation to control some pet project.

In general, the book is both informative and entertaining. It is well written and easy reading. Anyone interested in the development and administration of grazing on the public domain should plan to spend a night with this book.

Photogrammetry and Photo-Interpretation. *By* STEPHEN H. SPURR. *472 pp., illus., refs., index, 1960. The Ronald Press Co., New York 10, N. Y. $12.00. (Reviewed by* RICHARD C. WILSON, *Washington, D. C.)*

This second edition of *Aerial Photographs in Forestry,* in the words of the author, ". . . has been broadened to serve all nonphotogrammetrists who use aerial photographs as a professional tool." In large measure the book meets this objective.

The first three of the five major parts of the book cover the essentials of aerial photography, photogrammetry and aerial mapping. The principles of photogrammetry and general mapping applications are explained in very readable fashion with appropriate illustrations. Since the material has been expanded and improved in organization, these sections make the book an even better reference for student use than was the original volume which was widely and successfully used as a text for introductory courses in photogrammetry.

In Part IV the chapters "Principles and Techniques of Photo-Interpretation" and "Aerial Photography for Interpretation" draw some pertinent distinctions between procedures and materials applicable to photographic interpretation and those applicable to photogrammetry in a strictly engineering sense. Three other chapters on photo interpretation cover subject matter not discussed in the earlier edition—the interpretation of geology and soils, vegetation, and human activities and structures. These are worthwhile reading for anyone concerned with evaluation of natural resources or land uses, even though men attempting to specialize in any of these fields of interpretation will, undoubtedly, want to refer to more complete coverage in other publications. Such readers will find that Professor Spurr has provided helpful bibliographies at the end of each chapter.

The last part of the publication, "Forestry Applications," is an enlarged version of the main subject matter in the original volume. There is a brief chapter citing the main uses of aerial photography in forestry and tracing the history of applications in this field. The contents of the four chapters that follow are evident from their titles: "Measurement of Trees and Stands on Aerial Photographs," "Estimation of Diameter and Volume from Aerial Photographs," "Aerial Photographic Forest Surveys," and "Use of Photographs in Controlling Ground Inventory." Not only foresters but others concerned with resource inventories are likely to find an answer to a survey problem among the methods described; at least they may well find a lead that merits pursuing among the references to other methods which are only mentioned in this volume.

The last chapter, "Uses of Photographs in Forest Management," sketches in brief but informative fashion a variety of forest photo-interpretation applications such as those in mapping cover types, cadastral surveys, timber sale administration, road locating, fire protection and forest recreation.

This book, no doubt, will be welcomed by teachers in a variety of disciplines (e.g., in forestry, geology, geography, and soil science) who need a textbook for use in condensed courses of photographic interpretation and photogrammetry. The volume should also be a worthwhile purchase for the scientist or technician engaged in the investigation or management of natural resources.

Wild Life in an African Territory. *By* F. FRASER DARLING. *160 pp., illus., appendix, fold-out maps, index, 1960. Oxford University Press, 417 Fifth Avenue, New York, N. Y. $4.00. (Reviewed by* WALLACE E. AKIN, *Des Moines, Iowa.)*

This book is the result of a study by the author for the Game and Tsetse Control Department of Northern Rhodesia. The purpose of the study was to gain some insight into the possibility of game management in this part of Africa to conserve the animal and plant communities which are now threatened with destruction by man's activities. Although the central theme is wild life, Dr. Darling takes an ecological approach to the problems, considers man as the ecological dominant, and the wild, hoofed animals as one of the continent's principal economic assets.

Not only is this study an excellent example of the ecological approach to the analysis of resources problems, but it is one of the best pieces of descriptive literature about a part of Africa that this reviewer has encountered. It is to be recommended as a source of information about the natural habitat and wild life of Northern Rhodesia, as well as a pattern which might be followed in the analysis of similar problems in other areas.

Current Literature Briefs

Fish and Wildlife

Federal Aid in Fish and Wildlife Restoration. 96 pp., illus., 1961. Wildlife Management Institute, 709 Wire Building, Washington 5, D. C.

This booklet, prepared in the Bureau of Sport Fisheries and Wildlife, is an annual report on Dingell-Johnson and Pittman-Robertson programs for the fiscal year ending June 30, 1960. It is published by the Sport Fishing Institute and the Wildlife Management Institute.

Quetico-Superior Wilderness Research Center Annual Report. 10 pp. 1961. Wilderness Research Foundation, 3220 Prudential Plaza, Chicago 1, Illinois.

Trout in Farm and Ranch Ponds. *A. E. Borell* and *P. M. Scheffer.* 18 pp., illus., 1961. Farmers' Bulletin No. 2154. U.S. Government Printing Office, Washington 25, D. C. $0.10.

Making Land Produce Useful Wildlife. *Wallace L. Anderson.* 32 pp., illus., 1960. Farmers' Bulletin No. 2035. U.S. Government Printing Office, Washington 25, D. C. $0.15.

This popular bulletin provides essential information as to how to maintain a desirable biologic balance on the land while managing it to meet wildlife requirements.

Hook and Line Catch in Fertilized and Unfertilized Ponds. *Donald F. Hansen et al.* 45 pp., illus., 1960. Illinois Natural History Survey Division, Urbana, Illinois.

National Forest Wildlife. 16 pp., illus., 1961. U. S. Government Printing Office, Washington 25, D. C. $0.20.

This booklet, Part 2 of the U. S. Forest Service's "Operation Outdoors," explains in detail the short-term wildlife habitat management objectives outlined in the program for the national forests. It describes the size and nature of the problem and sets forth objectives.

Water Resources

Flood Proofing: An Element in a Flood Damage Reduction Program. *John R. Sheaffer.* 198 pp., illus., 1960. Research Paper No. 65. University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Illinois. $4.00.

One of several available adjustments to mitigate flood losses is flood proofing. This adjustment consists of measures to render buildings, their contents and grounds less vulnerable to flood damage. This report analyzes the advantages and limitations of flood proofing.

Interstate-Federal Compact for the Delaware River Basin. 27 pp., 1961. Delaware River Basin Advisory Committee, 930 Suburban Station Building, Philadelphia 3, Pennsylvania. (free)

Signatory parties to the Compact are the Federal government, the States of Delaware, New Jersey and New York, and the Commonwealth of Pennsylvania. The principal purpose of this compact is to create a regional Federal-interstate administrative agency which shall act for and be responsible to the five parties in the planning, development and control of water resources of the Delaware River Basin.

Water Inventory of the Maumee River Basin. 112 pp., illus., 15 fold-in maps, 1960. Report No. 11. Department of Natural Resources, 1662 West First Avenue, Columbus 12, Ohio. $3.85.

Evaporation Control Research, 1955-58. *Robert Cruse* and *G. Earl Harbeck, Jr.* 44 pp., illus., refs., index, 1960 Geological Survey Water-Supply Paper 1480. U. S. Government Printing Office, Washington 25, D. C. $0.50.

Snow Avalanches—A Handbook of Forecasting and Control Measures. 84 pp., illus. 1961. U.S. Government Printing Office, Washington 25, D. C. $0.60.

The Economics of Irrigation in Dry Climates. *Colin Clark.* 31 pp., 1960. University of Oxford, Agricultural Economics Research Institute, Parks Road, Oxford, England. (approximately $0.70)

Water Policy and Legislative Recommendations of the Ohio Water Commission. 45 pp., illus., 1961. Ohio Department of Natural Resources, 1562 West First Avenue, Columbus 12, Ohio.

Factors Affecting Moisture-Storage Efficiency of Dryfarming Areas in the Great Plains. *H. H. Finnell.* 16 pp., 1960. Production Research Report No. 37. U.S. Government Printing Office, Washington 25, D. C.

"An excellent introduction to water resources." —Journal of Soil and Water Conservation

WATER FACTS FOR THE NATION'S FUTURE

Walter B. Langbein, U. S. Geological Survey; and William G. Hoyt, formerly U.S. Department of the Interior

Timely book offers an authoritative study of federal and state hydrologic programs for collecting, interpreting, and publishing water data. It gives practical recommendations for expansion and improvement; outlines specific steps that must be taken. Presents many suggestions for improving the design of hydrologic networks. *A Conservation Foundation Study. 1959 288 pp.* **$5.00**

Also sponsored by The Conservation Foundation—

The Flood Control Controversy, Leopold-Maddock $5.00
The Law of Water Allocation in the Eastern United States, Haber-Bergen $7.50
Fresh Water from the Ocean, Ellis $6.00
Conservation Law and Administration, Schulz $10.00
Living Resources of the Sea, Walford $6.00
Wildlife in Alaska, Leopold-Darling $3.00

FOREST MANAGEMENT

H. Arthur Meyer, Pennsylvania State Univ.; Arthur B. Recknagel, St. Regis Paper Co.; Donald D. Stevenson, Buckeye Cellulose Corp.; Ronald A. Bartoo, Pennsylvania State Univ.

New! Second Edition consolidates a wealth of basic technical material and important data on recent advances in forest management. Book clearly describes fundamental considerations governing organization and operation of forest properties for sustained yield; fully covers conservation of resources, forest plans, management inventories and growth data, etc. *2nd Ed., 1961. 282 pp.* **$8.50**

PHOTOGRAMMETRY and PHOTO-INTERPRETATION

Stephen H. Spurr, The University of Michigan

2nd Edition of "Aerial Photographs in Forestry" covers all major developments in the techniques of aerial photography, photogrammetry, and photo-interpretation. Brings together up-to-date material on aerial photography in vegetation mapping, forest inventory, forest management, etc. Abundantly illustrated. *"Exceptionally interesting and instructive."*—**Soil Science.** *2nd Ed., 1960. 472 pp.* **$12.00**

AMERICA'S NATURAL RESOURCES

Edited by a Committee headed by Charles H. Callison, National Wildlife Federation

A factual survey of our natural resources, their interdependence, and conservation. Experts describe each major renewable resource, point out its importance, the dangers threatening it, and methods for preserving and using it most profitably. *"An excellent resource book."*—**Soil Conservation.** *Edited for the Natural Resources Council of America. 1957. 211 pp.* **$4.00**

Order your books from:

THE RONALD PRESS COMPANY
15 East 26th St. New York 10

NEW AQUATHOL FOR FAST, SAFE CONTROL OF UNDERWATER WEEDS

In just a few days Aquathol can clear ponds and lakes of troublesome underwater weeds . . . without harm to fish or other water life . . . and leave water safe for domestic and recreation uses. Developed exclusively by Pennsalt, Aquathol is easy to apply—effective.

Ask your farm chemical distributor or write Pennsalt Chemicals Corp., Aurora, Illinois; Montgomery, Alabama; Bryan, Texas, or 3239 Mayfair Boulevard, Fresno, California.

a product of Pennsalt research . . .

AQUATHOL*

**A trade-mark of Pennsalt Chemicals Corp.*

Water Pricing and Allocation with Particular Reference to California Irrigation Districts. *Michael F. Brewer.* 149 pp., mimeo., 8½x11 in., 1960. Report No. 325. California Agricultural Experiment Station, University of California, Berkeley.

Status of State Legislation Relating to the Watershed Protection and Flood Prevention Act. *R. Frank Hedges* and *L. M. Adams.* 14 pp., 1961. SCS-TP-139. Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C.

Proceedings of the National Conference on Water Pollution. 606 pp., paper cover, 1961. U.S. Government Printing Office, Washington 25, D. C. $0.25.

Moisture Storage and Crop Yields in the Dryfarming Areas of the Great Plains. *H. H. Finnell.* 31 pp., 1960. Production Research Report No. 39. U.S. Government Printing Office, Washington 25, D. C.

Multi-Purpose River Basin Development Part 2C. Water Resources Development in British Borneo, Federation of Malaya, Indonesia and Thailand. 150 pp., 1960. International Documents Service, Columbia University Press, 2960 Broadway, New York 27, New York.

This is a study of the physical and economic characteristics of the named countries, their water resources and stage of development with respect to flood control, irrigation and drainage, hydro-electric power, water supply, watershed management and multiple-purpose projects.

Other books concerning the water resource available from the International Documents Service include:

A Case Study of the Damodar Valley Corporation. 80 pp., 1960. $1.50.

This study describes the operations during 10 years of the Damodar Valley Corporation in India, which by and large followed the pattern of the Tennessee Valley Authority.

Hydrologic Networks and Methods. 180 pp., 1960. $3.00.

This report includes the lectures and special papers of the Inter-Regional Seminar on Hydrologic Networks and Methods held in Bangkok in July 1959.

Large-Scale Ground Water Development. 120 pp., 1960. $1.25.

This study deals with basic policy considerations relating to ground-water utilization, stages of ground-water development, economic and financial aspects, organization and administration, and groundwater legislation.

Education

Guide to Teaching Conservation and Resource-Use in Michigan. 186 pp., mimeo., 1960. Bulletin No. 425. Department of Public Instruction, State of Michigan, Lansing.

This guide is divided into six parts—mineral, land and soil, water, forest, wildlife, and human resources—with each part having an introductory basic statement followed by a list of understandings organized in four sections. Each understanding is then illustrated with one or more activities which will show how the understanding might be developed with children. Equipment needed and useful printed and audio-visual materials are listed for use with each section.

Science Projects Handbook. Shirley Moore, Editor. 252 pp., bibl., diagrams, paperback, 1961. Science Service, 1719 N Street N.W., Washington 6, D. C. $0.50.

SOIL TESTING AIDS CONSERVATION

LaMotte Soil Testing Service is the direct result of over thirty years of extensive cooperative research. All LaMotte Methods are approved procedures, field tested for accuracy in actual plant studies. These methods are flexible, and are capable of application to all types of soil with proper interpretation to compensate for special local soil conditions.

Outfits can be furnished for specific nutrient tests, or in combinations of tests to meet requirements. A copy of the LaMotte Soil Handbook is supplied with each outfit.

Literature and recommendations on soil testing equipment will be sent on request. No obligation.

La Motte

Chemical Products Company

Dept. S&W, Chestertown, Md. U.S.A.

Problem Solving Methods in Science Teaching. *Lester C. Mills* and *Peter M. Dean.* 88 pp., 1960. Bureau of Publications, Teachers College, Columbia University, New York 27, N. Y. $1.50.

This excellent monograph completed under the auspices of the Science Manpower Project has been prepared for the benefit of teachers, but would surely be of benefit to others who are in positions of providing organized instruction. The time-proven method of problem solving as an effective teaching method is described, and essential understandings of the method are given in the first chapter. Opportunities for effective use of this method are given in chapter two, while the remaining chapters discuss application of the method to instruction in the earth, biological, and physical sciences.

Federal Careers in the Sixties. 83 pp., illus., 1960. U.S. Government Printing Office, Washington 25, D. C. $0.60.

This publication, designed as a directory for college students, contains a brief commentary on Federal employment in general and describes separately the major Federal career occupations.

Notes from the Field

Rocks, Nature's Gift to the New England Farmer

R. A. STRUCHTEMEYER

NEW ENGLAND FARMERS have been removing stones from their agricultural lands for many years. To verify this all one has to do is to look around at the numerous stone walls that are so much a part of the picturesque New England landscape. In the past, as soil management practices changed and operations became mechanized, farmers felt an urgency in getting stones off their lands. Therefore, each time the soil was plowed the stones were picked up and hauled off the fields.

More and more mechanization is being recommended today as new crop production practices are initiated. When one views the situation from the vantage point of economics, New England farmers must mechanize as much as possible if they are going to compete in the marketplace.

One operation that has never been mechanized as much as most Maine farmers would like has been the harvesting of potatoes. Until recently, potatoes were lifted out of the soil mechanically and then dropped back on the ground. Someone then had to come along, pick the potatoes off the ground, place them in a basket and then finally dump them into barrels. Many people realized that there was too much lost motion in this operation so attempts were made to develop a mechanical harvester.

Numerous potato harvesters were developed and tried in the field. In all of the trials one thing stood out above all others, and that was the fact that the rocks in Maine soils made it very difficult to use any of these machines. Many farmers who wanted to use the harvester started to look for an answer. The obvious solution to the problem was to take the coarse material that was causing the trouble out of the soil before planting potatoes. Before long, mechanical rock pickers were developed. Most of these rock pickers used a picker chain that removed rocks over 1¼ inches in diameter.

Some potato growers have been mechanically picking rocks from their lands for a number of years; from some of these people questions are arising which indicate possible difficulties that might be resulting from such a practice. It seems logical that if 10 to 25 percent of the volume of a soil is removed in the form of rocks, the properties of the soil as a medium for plant growth may be changed. If the properties are changed, information is needed with regard to how these changes will influence the growing plant. This information should be obtained from controlled plots before too many rocks are removed. It is safe to assume that once the rocks are removed the farmer will not haul them back on the land.

Realizing that changes might be occurring in the soil when the coarse fragments were removed, a laboratory study[1] was conducted by the Maine Agricultural Experiment Station to check on the influence of coarse material on compaction, infiltration, runoff and erosion. Two important potato soils, namely, the Thorndike and the Caribou, were sampled.

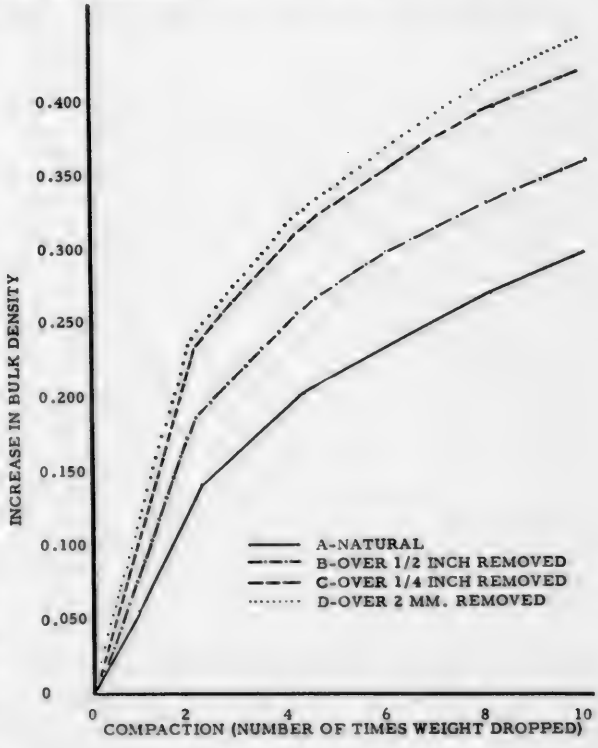
When the soils with the varying amounts of coarse material removed were exposed to compaction, it was very apparent in the Caribou soil that the presence of material over one-half inch in diameter reduced the compactibility of the soil. In the Thorndike soil, the resistance to compaction was pronounced with the presence of rocks down to the one-quarter inch size. The increase in bulk density for the Thorndike soil is shown in figure 1 and the same general trend was noted for the Caribou soil.

The soil treatments used in these trials were as follows:

Treatment	Size Category
A	Natural soil containing all the coarse material.
B	Material over one-half inch in diameter, removed.
C	Material over one-quarter inch in diameter, removed.
D	Material over two millimeters in diameter, removed.

Reduction in the compactibility of these two soils with the coarse material present was believed to be due to two things. The coarse material spread the compaction forces over a larger area which reduced the compaction per unit area of soil. The coarse fragments also offered resistance to compaction by forming a bridge-like network which cushioned the compression by

Figure 1. Effect of removing coarse material on the increase in bulk density of Thorndike soil, expressed as an increase over no compaction.



R. A. Struchtemeyer is head of the Department of Agronomy at the University of Maine, Orono, Maine.

[1] This study was made by W. J. Grant, soil scientist with the Soil and Water Conservation Research Division, Agricultural Research Service.

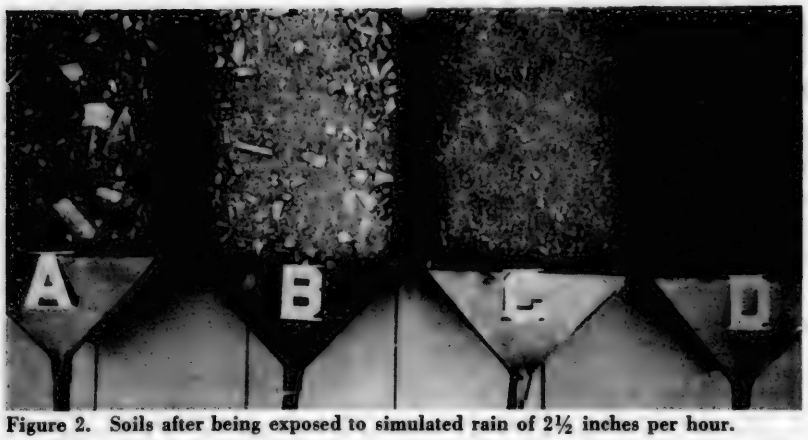


Figure 2. Soils after being exposed to simulated rain of 2½ inches per hour.

the compacting forces. This is probably why deep compaction and traffic soles have not been a problem in Maine, even in potato fields where there is a relatively large amount of tractor traffic.

Using special soil pans and a rainfall simulator, the influence of the coarse material on infiltration, runoff and erosion was investigated. The soils after treatment are shown in figure 2. The removal of the coarse material reduced infiltration and increased runoff. In this phase of the work the rock fragments down to one-quarter inch in diameter influenced the infiltration rate for both soils. The amount of soil lost was found to be directly related to runoff. Soil losses are presented in table 1.

The beneficial effect of coarse particles in promoting infiltration and reducing runoff and erosion may be attributed to three factors. First, coarse particles on the surface of the soil acted as a rock mulch by intercepting and dispersing the falling raindrops. This action decreased the amount of surface sealing which would definitely influence the infiltration rate. Secondly, the coarse material may have reduced the detaching action of the flowing water. A third factor may have been the increased non-capillary pore space associated with the coarse material.

Based on the data collected in this study, the possibilities that removing the coarse material might increase the erosion hazard and the compactability of the soil are adequate cause for the establishment of some field plots. An attempt will be made to verify some of the laboratory findings with field trials. Until such time as the results of these field trials are available, farmers should not be encouraged to remove stones from their fields. By removing the stones they might be destroying one of nature's greatest gifts to New England farmers.

TABLE 1
Effect of Coarse Material on Erosion of the Thorndike and Caribou Soils in Maine Under Laboratory Conditions.

Soil Treatment	*Soil Loss*[1] *Thorndike*	*Caribou*
A—Natural soil	0.13	0.46
B—Over ½ inch, removed	0.81	2.34
C—Over ¼ inch, removed	2.36	4.67
D—Over 2 mm., removed	4.08	7.34

[1] Grams of soil removed by runoff from soil sample (393.7 square centimeters) during one hour at a simulated rainfall rate of 2.5 inches per hour. Each figure is the average of three replicates.

SOIL MOISTURE AS RELATED TO DRAINAGE

A. N. GIBSON

WET SOILS have been a perplexing problem to farmers of the Gulf Coast Prairie of Texas for many years.

From Houston, on the upper end of the coastal farming area, which receives about 45 inches average annual rainfall, to Victoria on the Texas Coast Bend, with 35.5 inches annual rainfall, farmers have drained their heavy blacklands (Lake Charles clay) with systems of ditches varying in their effective water removal ability. Too often the success of a drainage system has been judged by the speed and thoroughness with which rainfall could be removed from the surface of the land.

Conservation farmers and technicians with their knowledge of soils, crops and consumptive use of water often wondered about the manner and intensity of drainage. Was the water in contact with the land surface long enough and uniformly enough to get needed plant moisture into this deep, slowly permeable soil? Cotton and maize crops could well use the full amount of the annual average rainfall, but in some cases more than 50 percent of this rainfall was being removed by the drainage systems.

The need for research information was great but data for guidance in this area on this problem were not available. An opportunity arose to compare intensities of surface water removal on two adjacent farms with the same soil conditions, near Victoria, Texas. The soil was Lake Charles clay, Soil Unit 2, Coast Prairie, on smooth uniformly sloping land with a 0.035 percent gradient. This article is a report of the study of the drainage on the two farms, identified as "A" and "B."

Farm "A"

The study was prompted by a set of circumstances dating back to 1949 when conservation planning was initiated by the operator of farm "A" with the technical help of the Victoria Soil Conservation Service Work Unit. Tillage practices and the cultural treatment of the farm "A" prior to 1947 resulted in poor soil structure. Tillage on both farms had been done by bedding and rebedding without flat breaking. No water furrows, ridges, turn rows or lands had been developed by tillage. Due to natural topography and previous tillage methods, a smooth uniform gradient was maintained throughout the history of cultivation of these farms, comparable or superior to that normally obtained by land grading.

According to the 1949 Soil Conservation Service Coast Prairie Capability Guide and drainage practices in effect at that time the recommended field drain spacing for a particular field (field "a") on farm "A" was 500 feet. Row drainage at this spacing would have required four surface field ditches. Plans were developed for the field for the required ditches, however, only one ditch was ever constructed; this was along the lower edge of the field and resulted in a length of row to be drained that was 2,000 feet long.

A. N. Gibson was an engineering specialist with the Soil Conservation Service, Victoria, Texas, at the time this article was written. Mr. Gibson is now on assignment with the International Cooperation Administration, New Delhi, Lucknow, India.

No ill effects from poor drainage were noted from 1949 through November 1959. Beginning in 1950, annual rainfall in the area began to diminish. In February 1957, the period of drought was broken and rain continued to fall throughout the late winter and spring months until 20.5 inches of rain had fallen during the preplanting and early growth stages of cotton and grain sorghums. Cotton in rows 2000-feet long, having a total uniform overall fall of 0.7 foot, with a field ditch of less than normal dimensions did not show stand or color significant of poor drainage.

Farm "B"

Across the road and 100 feet west is a field (field "b") on the farm "B" with soil type, slope and cropping history the same as that on field "a". Row length here was 500 feet and installed field drains were of acceptable dimensions and were in good condition.

1957 Observations

Soil samplings[1] to determine percentage of soil moisture were taken at three levels from the surface to a depth of 36 inches at the upper and lower ends and in the middle of the 2000-foot rows on field "a". Similar soil moisture determinations were made on field "b". Soil sampling was done on July 26, September 9, September 11 and December 18, 1957. The significant observations on soil moisture were:

1 Rainfall for 1957 was 47.56 inches. This amount is 11.9 inches above normal. From observations made during periods of heavy rainfall, it is believed that more than 50 percent of the rainfall was removed through the ditch at the lower edge of field "a".

2 The July and September readings showed all sites in fields "a" and "b" to be considerably below field capacity of 37½ percent. The soil moisture range was from 10 percent to about 25 percent based on oven dry weight of the soil.

3 At the time of fruiting, July 22-26, 1957, moisture in the soil of field "a" was less than 50 percent field capacity and in the upper end of the field was only 12½ percent. Field "b", with the 500-foot rows, showed less moisture than field "a" at 36 inches as of July 22-26, 1957, indicating less penetration of moisture.

4 Field capacity at the 36-inch depth on the 2000-foot rows in field "a" was not reached until December 18, 1957. Moisture was 5 percent less than field capacity on 500-foot rows in field "b" at this time.

5 The 2000-foot rows in field "a" did not have any sites testing an excess of moisture at any time.

1958 Observations

During 1958, the observed percentages of moisture in the soil on fields "a" and "b" at varying depths to 36 inches with 2,000-foot and 500-foot row lengths showed that the longer rows had a better reserve of moisture. With the 1958 rainfall of 41.01 inches, which was 5.35 inches above normal, all rows and depths with one exception showed moisture below field capacity in the root zone.

Moisture percentage determinations made during the forepart of 1958 indicated that the 47.56 inches of rain during 1957 (26.5 inches of this amount fell during the latter four months of 1957) had not induced field capacity in the effective root zone depth on the 2000-foot rows at planting time, April 1958, even though an additional 12.06 inches of rain fell during January, February and March of 1958. By June 7, 1958, the moisture in the top one-fourth of the root zone was at the permanent wilting percentage. At no time during 1958, with its 41.01 inches of rain, did the 36-inch root zone depth in the 2000-foot rows reach field capacity. The November 6, 1958, moisture percentage determinations showed that the 2000-foot rows had approximately 5 percent more available moisture than the 500-foot rows. Using a volume weight of 1.70 and a root zone depth of 3.0 feet, the increase in available moisture in the field with 2000-foot rows was determined to be 3.06 inches.

The crops of maize and cotton in 1957 and 1958 were 50 percent of record production on these lands. Rainfall distribution was also a contributing factor to lower production.

Field observations on the 2000-foot rows did not show or reveal any condition of soil or crop indicative of damage from poor drainage, ponding or lack of aeration. Nearby farmland with similar soil and slope and planted to similar crops but with irregular surfaces conducive to ponding suffered damage.

1959 Observations

The 1959 determinations of soil moisture percentages were made at increments of 9 inches from the soil surface to depths of 36 inches at various sites on the 2000-foot rows on field "a" and on the 500-foot rows on field "b". Soil moisture in field "a" ranged from 31 percent to 37 percent on the 2000-foot rows at planting time, April 1, 1959. The 500-foot rows on field "b" as of the same date had moisture ranging upward from 25 percent at comparable depths. Sampling of the various sites and depths on the 2000-foot rows indicated an increase in soil moisture as the opportunity time for intake increased from the upper ends of the rows to the lower or outlet ends. The moisture percentage on June 19, 1959, was 5 percent greater in the top one-fourth of the root zone on upper ends of the 500-foot rows than on the upper ends of the 2000-foot rows.

Conclusions

These observations of drainage on fields "a" and "b" indicate:

1 Rows 2000 feet in length or longer may be used on deep, fine textured, slowly permeable soils on gradients of 0.05 percent or less where surplus water is removed and the surface does not pond or impound water.

2 Better moisture conditions prevail in soils on rows of greater length under normal and abnormal rainfall in the 35-inch Gulf Coast rainfall belt.

3 Longer rows for drainage purposes require less construction and maintenance costs.

4 Rilling at the end of the 2000-foot rows on 0.035 percent slope appears no greater than on 500-foot rows on the same slope and soil; erosion loss on the 2000-foot row lengths may be less.

5 Depreciation of tillage and planting equipment attendant to crossing field drains is reduced.

6 There is an opportunity for better utilization of rainfall by blocking rows to hold runoff on soils of uniform low gradient. This type of management is practiced on irrigated lands and is a pattern of use for water received as rain.

7 Research is needed relative to the degree of drainage required considering soil, topography and management.

---

[1] Moisture percentage and volume weight determinations were made by or under the supervision and direction of Soil Conservation Service soil scientists. The samples were sealed in cans in the field and were immediately taken to the laboratory; they were weighed and then dried in an electric oven at 110 degrees Centigrade. Volume weights were determined by soil scientists by the paraffin-dip method. Assistance from the Victoria area and work unit staffs in collecting data for this report was greatly appreciated.

Land Use Changes in the Pine River Watershed

NORMAN J. BROWN

THE PINE RIVER WATERSHED in Osceola, Lake, Wexford and Manistee Counties in Michigan was designated for special attention by the Conservation Commission in 1952; subsequently a watershed project was initiated by the Fish Division of the Michigan Department of Conservation in the interest of improving and maintaining the trout streams of the river system.

The first step in developing this watershed project was to complete a survey designed to gather and compile information on both the streams and uplands within the project area. The upland phase of this survey consisted of obtaining information on land use, vegetative cover, ownership, topography, soils and human settlement. These data were summarized and analyzed to form a basis for the determination of upland improvement needs.

The Pine River, according to the survey, has a drainage area of 180,000 acres, of which 150,000 acres contribute surface runoff to the stream. This article is concerned only with the acreage contributing surface runoff.

Most of the watershed is under private ownership, with a few large holdings by private clubs and one public utility. The 23 percent of the watershed in public ownership (largely Federal) includes part of the Manistee National Forest and this acreage for the most part is in excellent vegetative cover.

The watershed topography ranges from level to hilly as a result of glacial deposits, and is typical of this general northern Michigan area. The soils range from deep sands to clay loams, but consist mainly of sand and sandy loams. The clay soils are concentrated in one small area of one minor sub-watershed.

The land use was divided into five principal categories for survey purposes. These categories with the acreage of land and the percentage of the total land in each are listed in table 1. Because of the predominance of the hilly, sandy land in the watershed, a majority of the cropland and permanent pasture was found to be on land not capable of supporting this use without excessive runoff and erosion. The surveys indicated that here was a major source of sediment contribution to the stream.

Sedimentation has many ramifications, one of which is the destruction of trout habitat. Damaging effects of this type of pollution are summarized by Eschmeyer (2) as follows: "These waters when added to streams fill pools, cover rich food-producing areas with barren materials, increase turbidity and decrease productivity, destroy cover and plant beds, and in extreme instances completely fill the channel and obliterate flow or convert the stream into a shallow meandering sheet of water largely devoid of fish and insect life."

After the basic data were gathered an organizational meeting was called by the Department of Conservation. All the agencies[1] that served or represented the landowners in the Pine River project were asked to send representatives to the meeting. The objective of this meeting was to coordinate the conservation program of all the agencies toward a common goal.

The agency representatives agreed that the greatest reduction in upland sediment could be accomplished by a shift in land use from cropland and pasture to forest and recreation land. A program of two major parts was then outlined to initiate this necessary change. One part was to reforest the light soils, and the other was to conduct an informational and educational program to acquaint the landowners with the hazards in continuing to farm this class of land. This encouraged the abandonment of sub-marginal farm land and its conversion to forest.

In 1958, after this program had been in effect for six years, the entire watershed was resurveyed. The land was classified into the same categories as in the original survey. As shown in table 1, there was a marked decrease in cropland and permanent pasture and a corresponding increase in recreation and forest land.

This increase in forest land is a good example of what can be accomplished when various agencies work together toward a common goal. The average acreage planted to trees increased from 15 acres per year for a 5 year period prior to the initiation of the project to 582 acres per year during the period 1953 to 1958.

The decrease in farming activity in the watershed also had an effect on forest management. As agriculture was discontinued on the sub-marginal lands, the grazing of forest lands was reduced. The amount of reduction in grazing of woodlots is shown in table 2.

Landowners were encouraged to sign agreements with the Soil Conservation Districts. They would then be eligible to receive assistance from the Soil Conservation Service in establishing a basic soil and water conservation plan for their farms as well as help with necessary soil conservation practices to implement the plan. The districts have signed agreements with 206 landowners and have completed basic plans on 104 farms in the watershed. This has resulted in the establishment of 3,981 acres of pine plantations, 83 miles of constructed waterways, 1,061 acres of strip cropping on eroded fields and 10 farm ponds. Some of the predominantly agricultural sub-watersheds have approximately 70 percent of the land farmed under a basic soil and water conservation plan.

In certain areas of the United States, a land use alteration of such extent has a marked effect on amount of sedimentation in streams and reduction of flood peaks. This is shown by a study made at the Coweeta Hydrologic Laboratory in North Carolina (1) that indicated a 79 percent reduction in permeability of the soil on hardwood woodlots heavily grazed by cattle, under conditions indigenous to this particular region. This same study also showed that the three greatest changes in flood peaks and sedimentation were caused by shifting land from forestry to cropland, thereby increasing yearly soil losses from

[1] Participating agencies: *Soil Conservation Districts, *Agricultural Stabilization and Conservation Committees, County Road Commissions, *Soil Conservation Service, United States Forest Service, *Cooperative Extension Service, United States Geological Survey and United States Weather Bureau. (*Agencies which work directly with the individual landowner.)

TABLE 1

Summary of Land Use Changes in the Pine River Watershed, 1953-1958.

Land Use	*1953*	*1958*	*Percent Change*	*Acreage Change*
Cropland	27,528	20,420	−26	− 7,108
Pasture	21,050	11,040	−48	−10,010
Idle Recreational	9,800	21,765	+55	+11,965
Forest	91,072	96,225	+ 5	+ 5,153
Misc. (Towns & Lakes)	630	630		
Total	150,080	150,080		

TABLE 2

Changes in Forest Management in the Pine River Watershed.

Land Use	*1953*	*1958*	*Percent Change*	*Acreage Change*
Grazed woodlots	24,116	11,589	−52	−12,527
Ungrazed woodlots	52,529	65,056	+24	+12,527
Pine plantations	14,427	19,580	+36	+ 5,153
Total	91,072	96,225		

1.8 tons per acre to a maximum of 200 tons per year, with maximum flood peak more than 8 times greater than would have been expected had the area been left in forest.

The shift in land use from grassland to pines should have a marked effect on the surface runoff in the Pine River Watershed. This change could reduce seasonal runoff as much as one-third of the original amount (3).

This project was set up as operational rather than experimental, and gauging has been kept at a minimum. There are three United States Geological Survey stream gauges on the streams within the watershed; these should provide information at a later date concerning reduction in flood peaks and changes in maxmium flow.

Personal observation, substantiated by interviews with fishermen, landowners and other interested parties, clearly indicates that the original goal of improving and maintaining the trout streams in the Pine River system is being accomplished.

REFERENCES CITED

1. Dills, Robert E. 1957. *A guide to the Coweeta Hydrologic Laboratory*. U.S. Forest Service, S.E. Forest Expt. Sta., Asheville, N. C.
2. Eschmeyer, R. W. 1953. *Wildlife Management*. Vol. II, American Forestry Series. McGraw Hill Book Company, New York, N. Y. p. 377.
3. Kittredge, Joseph. 1954. *Influences of pine and grass on surface runoff and erosion*. Jour. of Soil and Water Cons. 9(4): 179-185 July.

Norman J. Brown is a land use specialist for the Fish Division of the Michigan Department of Conservation and is stationed at the Department's experiment station at Houghton Lake.

Abandoned farmland (top photograph) in the Pine River Watershed as it appeared prior to planting trees (bottom photograph) for protection against wind and water erosion.

AUDIO-VISUAL AIDS

Filmstrips: Soils. 5 separate strips, color, 1960. Marian Ray, 36 Villiers Avenue, Surbiton, Surrey, England. $20.00 (set of 5), $4.00 (each).

These five filmstrips, accompanied by the script booklets, present in an informative and fascinating manner fundamental facts concerning the soil. They are very well done.

The individual filmstrips may be used effectively alone or the set may be integrated. Filmstrip 1 is titled, "Rocks and Erosion" and depicts the effects of weather; erosion and deposition by wind, rivers, glaciers, and the sea; igneous, sedimentary and metamorphic rocks; and the cycle of geological change. Filmstrip 2, titled, "Plants and Decay," presents material on plants and the soil; soil fauna, bacteria, and fungi; the carbon cycle, peat, coal; and the nitrogen cycle and humus.

"Soil Profiles and Their Formation" is the title of Filmstrip 3. This discusses the five factors important in forming soil and how soils are mapped. Filmstrip 4, "The Composition of Soil," presents information on the mineral fraction; soil, air and water; tilth; colloids and base exchange; roots and the soil. "Soil and Farming," Filmstrip 5, depicts cropping contrasted with natural vegetation, medieval three-course rotation, Norfolk four-course rotation, and types of modern farming.

The Society in Action!

SOCIETY ELECTIONS IN PROGRESS

During early May, all members of the *Society* with dues paid for 1961 received a ballot for the *Society's* annual election. Members are encouraged to return their ballot promptly; it must reach the *Society's* office no later than July 10, 1961, to be counted by the election committee.

Candidates for office and Council include:

President: ROY D. HOCKENSMITH, Director, Soil Survey Operations, Soil Conservation Service, Washington, D. C.

First Vice President: GEORGE M. BROWNING, Associate Director, Iowa Agricultural Experiment Station, Ames, Iowa.

Second Vice President: HERBERT A. HOPPER, Field Representative, Soil Conservation Division, State of California, Lafayette, California, and

JAMES K. VESSEY, Regional Forester, U. S. Forest Service, Atlanta, Georgia.

Treasurer: HOWARD F. BARROWS (retired), St. Augustine, Florida.

Council Member at large: (Five candidates have been nominated for this position)

CECIL W. CHAPMAN, State Conservation Service, Athens, Georgia.

INGVALD O. HEMBRE, Executive Secretary, State Soil Conservation Committee and Extension Soil Conservationist, Madison, Wisconsin.

RAMON L. KENT, State Soil Conservationist, Soil Conservation Service, Spokane, Washington.

JOHN T. LOUCKS, recently joined Bober Seed Company, Rapid City, South Dakota —formerly Area Conservationist, Soil Conservation Service, Rapid City, South Dakota.

HAROLD M. RHODES, State Conservation Engineer, Soil Conservation Service, Morgantown, West Virginia.

Council Member Western Region: (only members in Western Region will vote)

JOHN R. J. BRADSHAW, Assistant State Conservationist, Soil Conservation Service, Salt Lake City, Utah.

Council Member Canadian Region: (only bers in Canadian Region will vote)

H. F. CROWN, Executive Assistant to the Minister of Commerce and Development, Department of Planning and Development, Toronto, Ontario, Canada.

All individuals consented to have their names appear on the ballot and all were nominated in accordance with the bylaws of the *Society* whereby a chapter at a regular or special meeting may petition the nominating committee; or where 10 or more *Society* members sign a petition for the individual. Such nominations must appear on the ballot unless the individual is unwilling to serve. The nominating committee may also consider nominations presented by an individual and may, if they desire, nominate as a committee. All candidates for the current election have been nominated by the first two methods.

Officers and Council members now holding these positions may be noted on the masthead of the JOURNAL.

For the position of Council member at-large and for officer positions the bylaws state that the name of only one candidate from a region may appear on the final ballot. This year it was necessary to hold a "runoff" election in the Southeastern and North Central Regions.

The rainulator, recently developed by U. S. Department of Agriculture scientists at Purdue University. Persons taking the South Tour will have an opportunity to see it in operation. (See story on page 142)

MERIT AWARDS ANNOUNCED

Merit Awards given by the *Soil Conservation Society of America* for entries made by chapters in 1960 were announced recently.

"Water Street U.S.A.", an educational project of the Arizona—Sonora Desert Museum and the Charles Lathrop Pack Forestry Foundation received a Merit Award, Type II. Formal presentation of the recognition was made by Russell G. Hill, past president of the *Society*, at the Eighth National Watershed Congress in Tucson, Arizona, on April 17.

Hill stated, "The Watershed Exposition has proven an excellent device for impressing upon all visitors the value of soil and water management. The exposition and printed material about the project has been of great value in the educational work of many organizations and visitors to the project number in the thousands. This project, nominated by members of the Arizona Chapter *SCSA*, is one of the most outstanding educational devices that has been submitted for recognition."

Another Merit Award, Type II, was given the publication "Conservation of Our Renewable Natural Resources," a joint effort of the Washington, D. C., Chapter *SCSA*, and the National Capital Section of the American Society of Range Management. The publication is a booklet of suggestions for science fair projects by junior and senior high school students and has been widely distributed in the Washington metropolitan area. The project was nominated by the Washington, D. C., Chapter *SCSA*.

The "Conservation Slide Set," a series of colored slides with a written description for use by the moderator and a project of the Iowa Chapter *SCSA*, received the *Society's* Merit Award, Type II. This set has been prepared in several duplicates and used extensively in Iowa by teachers and other groups desiring to present accurate information about conservation. The slides, about 50 in number, were selected by a special chapter committee from among several hundred submitted by Iowa Chapter members.

The *Society's* Merit Awards Program is designed to recognize outstanding books, articles, movies, novels, advertisements, circulars, exhibits, radio, television and other programs designed to advance soil and water conservation.

Closing date for entries in the 1961 event is now past but *Society* members interested in this activity may secure information from the Executive Secretary.

All Lanes Lead to Lafayette

The day when the forester, the biologist, the soil conservationist, the agricultural extension agent, the hydrologist, or the recreation planner could go it alone is long gone. The only way the conservation job can be done is by cooperation, understanding, exchange of information and genuine teamwork between State, Federal, and private land resource people working in all areas of conservation.

We must look at conservation in the light of the interdependency of all programs, whether they be in water, forestry, game and fish, soil conservation, mineral development, or recreation.

—Orville L. Freeman[1]

THE SIXTEENTH ANNUAL MEETING of the *Soil Conservation Society of America* to be held on the campus of Purdue University, Lafayette, Indiana, July 30-August 2, 1961, offers you an opportunity to be a part of an organization and a conference aimed at continuing a leading role in natural renewable resource conservation. Featuring the theme "Land Use in a Changing Agriculture," a vital program providing for individual participation and presentations by singular authorities has been arranged in superb surroundings. Everyone is urged to complete an advance registration and prepayment form and send it to *SCSA*, Box 647, West Lafayette, Indiana, prior to July 1. This form appeared on page 93 of the March-April issue of the JOURNAL and another copy was sent to every *Society* member with his annual election ballot last month.

This annual meeting should enable many to combine a fine vacation trip with attendance at an important nationwide meeting. See the map on the next page for interesting points to visit enroute to Lafayette. Brief articles on succeeding pages also describe experimental farms and watershed projects you may wish to see.

Make sure that excellent reservations are held for you at the economical rates prevailing at Purdue University! Avoid unsatisfactory accommodations and long lines! Mail your reservation today! Remember to include your check in the amount of $17.80 to cover registration fees and meals during the meeting.

COPIES of the meeting program have recently been mailed to every *Society* member with dues paid for 1961. In addition to the general program at which all are welcome, a special ladies' program has been arranged based on the theme "Conservation of Human Resources." Special children's and teenagers' programs featuring recreational pursuits of all kinds have been planned.

THE CHAPTER ACTIVITIES COMMITTEE urges every *SCSA* chapter to have two representatives participate in the chapter workshops to be held during the afternoon of the first day of the annual meeting. These sessions have proven of distinct value to chapters as they initiate and carry out action programs of conservation. Chapter representatives may participate in their choice of six different workshop-discussion sessions. Send the names of your chapter's representatives to Tom L. Ayers, 4529 Butterworth Place, Washington, D. C.

A DISPLAY of chapter newsletters is to be made at the annual meeting. To make this activity most valuable each chapter publishing a newsletter is asked to participate. All that a chapter need do is select one newsletter published during the past year, make 125 copies of it and mail them before July 10, to Clyde McKee, College of Agriculture, Purdue University, Lafayette, Indiana. A packet containing one copy of every newsletter sent will be made for each chapter. Here's an activity loaded with ideas! Will your chapter participate?

HAS YOUR chapter entered the Chapter Activities Contest this year? Every chapter has either a total chapter program or a single outstanding chapter activity which merits entry in this *Society* contest. Share your chapter's successful program ideas with others!

Entries in these contests must reach the appropriate regional Council member by May 31, 1961. Student Chapters should send their entry to I. O. Hembre, Soils Building, University of Wisconsin, Madison 6, Wisconsin.

TOURS are scheduled for the afternoon of August 2. Indicate on the advance registration form which one you wish to take. Tour charges for the first three tours will be approximately $2.00; ladies' tours are free.

South Tour. Soil and water conservation will be featured on this tour. The Purdue—Agricultural Research Service rainulator pictured on the facing page will be in operation. Other highlights of this trip include a 900-acre level farm featuring an efficient corn-hog operation, sloping land farms showing good land use and intensive conservation practices, and visits to Eli Lilly Company (antibiotics production), American Marrietta Company (concrete products), and Ralston Purina Company (animal feed production).

East Tour. Well-planned family-type farm operations demonstrating wise and coordinated use of land, capital, and human resources are tour features. Visits will also be made to the 800-acre VanNatta estate, a fine Hereford cattle breeding operation, and to Prophet's Rock and Tippecanoe Battle sites. The story of the Illinois-Indiana Valley Compact for protecting and developing the 33,100 square mile watershed covering two-thirds of Indiana and one-seventh of Illinois will also be told.

North Tour. Championship corn production and high level management of very productive soil are features of this tour. J. Herbert Roadruck, hybrid seed corn producer, presently averages 160 bushel per acre corn yields on 240 acres. Members of this tour will also see: a "push button" livestock production program on level land; Farm Bureau Cooperative Poultry Breeding Research Farm; Indiana State Soldier's Home and Tippecanoe Battle site.

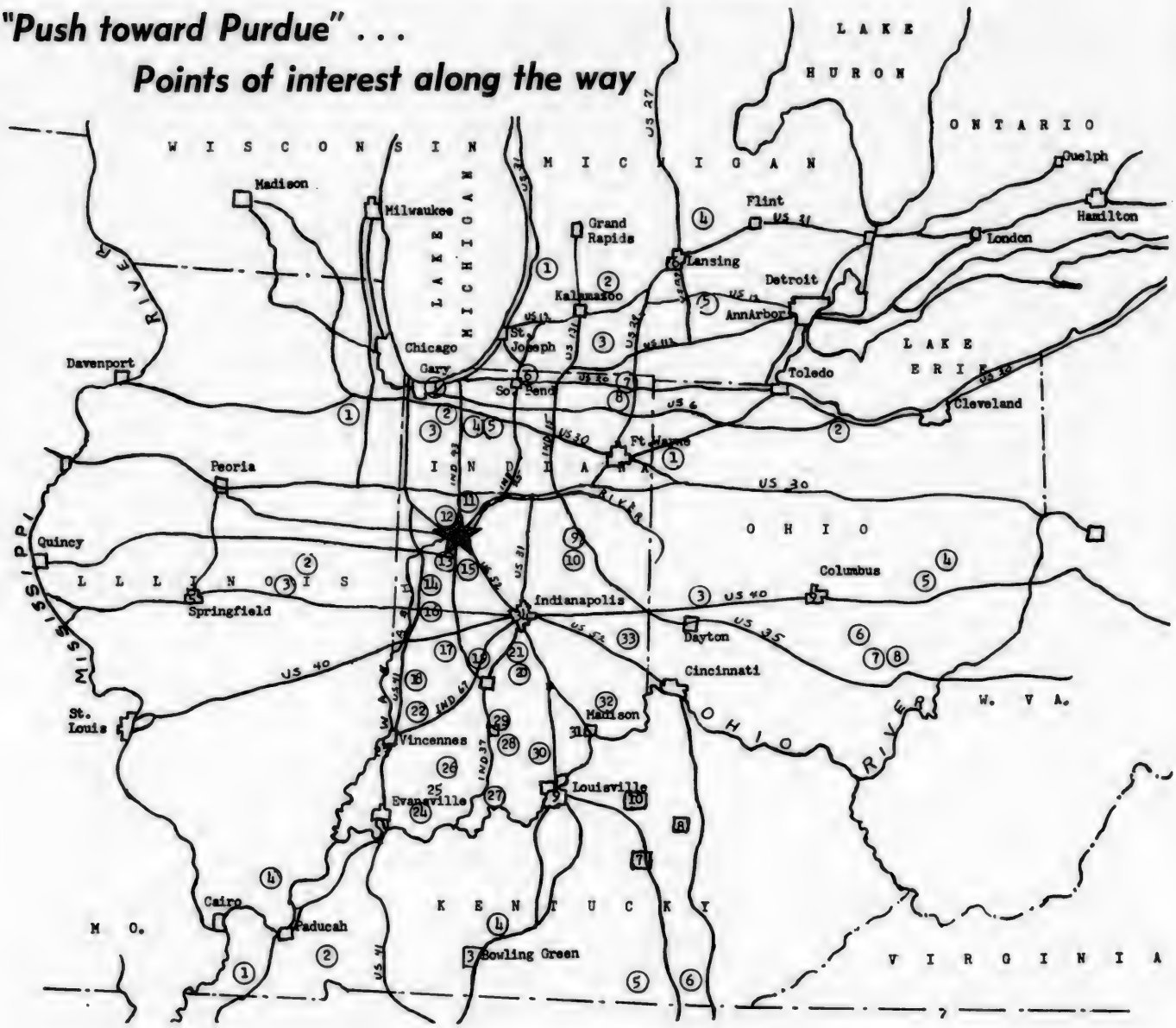
Women's Tours. There will be two tours for women. The Women's Historical Tour and the Women's National Homes Tour.

---

[1] From an address by the United States Secretary of Agriculture, Orville L. Freeman, before the National Water Research Symposium, March 29, 1961, Washington, D. C.

"Push toward Purdue" . . .

Points of interest along the way



INDIANA

1. Dunes State Park on the shores of Lake Michigan.
2. Pinney-Purdue Experimental Farm—dairy, livestock and forage production on sandy soils.
3. Jasper-Pulaski State Game Farm and Preserve and Forestry Nursery.
4. Sand Experimental Farm—grain and forage crops on deep sands with and without irrigation.
5. Culver Military Academy.
6. Notre Dame University.
7. Pokagon State Park on beautiful Lake James.
8. Limber Lost Memorial.
9. Miller-Purdue Experimental Farm—forage and livestock production on clayey soils.
10. Mounds State Park—one of the largest Indian burial mounds ever found.
11. Tippecanoe Battle Field.
12. Purdue University—"On the Banks of the Wabash," also, Agronomy Experimental Farm.
13. Throckmorton—soil and water conservation research—will be visited on "South Tour."
14. Turkey Run State Park.
15. Lew Wallace Home and Memorial.
16. Mansfield Reservoir—a flood control structure on Raccoon Creek.
17. Cagles Mill Reservoir and Cataract Falls—the first flood control reservoir constructed in Indiana.
18. Shakamak State Park.
19. McCormick's Creek State Park.
20. Brown County State Park.
21. World's largest goldfish hatchery.
22. Prairie Creek Watershed Project—channel work, floodwater detention structures, land stabilization structures and land treatment.
23. George Rogers Clark Memorial.
24. Lincoln State Park—home site where Lincoln spent his boyhood days, grave of Nancy Hanks Lincoln.
25. Santa Claus, Indiana and Santa Claus Park.
26. Southern Indiana Forage Farm—livestock and forage crop production on residual sandstone soils.
27. Wyandotte Cave.
28. Spring Mill State Park.
29. World's largest building limestone quarries and stone mills.
30. Elk Creek Watershed Project—first watershed project in operation in Indiana.
31. Clifty Falls State Park.

32. Versailles State Park.
33. White Water State Park.
34. Indianapolis—State capital and home of famous 500 mile Speedway.

ILLINOIS

1. Elwood Experiment Station—soil and water conservation research.
2. University of Illinois—agronomy farm and major research station.
3. Allerton Park—English style estate with formal gardens, Extension Center of the University of Illinois, watershed research.
4. Dixon Springs Experiment Station for southern Illinois—forage research, woodland research and erosion control.
5. Springfield—State capital.

KENTUCKY

1. Obion Creek Watershed Project.
2. Kentucky Lake State Park.
3. Bowling Green—Western State Teachers' College.
4. Mammoth Cave National Park.
5. Lake Cumberland State Park.
6. Cumberland Falls State Park.
7. Ft. Harrod, Daniel Boone County.
8. Lexington—University of Kentucky, Calumet Stables and other famous horse farms in the "Heart of the Bluegrass Country."
9. Louisville—Churchill Downs Track, home of famous Kentucky Derby.
10. Frankfort—State capital.

MICHIGAN

1. Swan Creek Wildlife Experiment Station.
2. Kellogg Wildlife Sanctuary and Experiment Fields.
3. Leidy Lake Wildlife Sanctuary.
4. Rose Lake Wildlife Experiment Station.
5. State Game Farm.
6. Lansing—State capital.

OHIO

1. Paulding Experiment Fields—drainage studies on clayey lake bed soils.
2. Castalia Experiment Station—drainage and dairy research on clayey lake bed soils.
3. Miami River Conservancy District—flood control structure on U.S. Highway 40 north of Dayton.
4. U.S. Hydrologic Experiment Station, Coshocton.
5. Muskingum River Conservancy District.
6. Upper Hocking (Pilot) Watershed Project.
7. Old Man's Cave and Cedar Falls.
8. Zaleski State Park.
9. Columbus—State capital, Ohio State University.

INDIANA SOLVES WATERSHED PROBLEMS

HARRY MOORE

WATERSHED PROBLEMS are community problems is the belief of folks living in many of Indiana's small watersheds. That is the reason applications for assistance with watershed problems had been prepared and were waiting to be submitted from three small watersheds when Public Law 566 was passed by Congress. To date, forty-two such applications have been received by the Indiana Flood Control and Water Resources Commission.[1]

It has long been recognized that water problems are primarily watershed problems. They are no respecter of farm or county boundaries. Problems start in the watershed where raindrops first hit the ground and do not stop until the water that runs off the land reaches the sea. Their best solution depends upon the proper use, management and treatment of the entire watershed. This requires community or group action.

Elk Creek Watershed in northeastern Washington County was the second watershed group in Indiana to request assistance under the Watershed Protection and Flood Prevention Act and was the first watershed on which a work plan was prepared. This watershed is not a wealthy community and the land is not the best in Indiana. Neither is it a large watershed, for it contains only 18,020 acres and 160 farms. Elk Creek rises in a steep area, locally called the "Knobs," and has slopes ranging from 30 to 60 percent. The waters of Elk Creek gain considerable velocity in this steep area and they have cut a complex drainage pattern into the relatively flat lowlands.

"Our problems," said the local leaders at their first information meeting, "are floods that ruin our crops in the bottoms, wash away our top soil, and damage our roads and bridges. They also deposit gravel and debris washed from the steep lands onto the bottom lands and in the drainage channels. Filling of the channels reduces capacity for handling flood waters and normal drainage and causes some ponding away from the main channel. Heavy rains have also caused severe erosion in our upland fields."

Recognizing these problems as too big to be solved individually, a group of leading farmers in the watershed got together to plan a course of action. What did they decide to do? Let's ask Joe Scifres, a bottom land farmer and now president of the Elk Creek Conservancy District.

"We started holding neighborhood meetings to try to determine whether there was enough interest to justify asking for assistance," Scifres says. "As soon as Public Law 566 was passed by Congress, the landowners petitioned for assistance. We soon found that getting the facts together and presenting them to the local people would be our biggest job. Since our project was the first one in Indiana, we had nothing to show our people."

"We all had one thing in common," stated Hagar Garriott, Jr., farmer and secretary of the Conservancy District. "We all wanted to stop the flooding of our farms and reduce our crop losses. We soon learned that good land use treatment on

[1] The Flood Control and Water Resources Commission is the State agency in Indiana assigned watershed responsibility.

A structure on the Elk Creek Watershed in Indiana. The crop below the structure is an irrigated field of late green beans.

the upland coupled with flood water detention structures and some channel improvement was the answer to our problem."

When the work plan was developed the total project was to cost $467,589 of which $183,496 was to be borne by the local people. How did the people raise these funds? Again, Joe Scifres gives us the answer. "We didn't want to levy a tax for these installation costs so we called a meeting of the people to decide how to raise the money. Farmers on whose land the structures were to be built quickly saw the advantages to them of having the use of the water from the sediment pool and their land protected by the structures. They readily agreed to furnish the sites. Farmers throughout the bottom lands who were being protected mutually agreed to donate cash and do clearing work on the sites in proportion to the benefits they would receive.

All structural work will be completed by 1962. Some changes in plans have been made since the work plan was developed. Seeing the value of having water for irrigation three farmers have added water storage to their structures for that purpose. The Fish and Game Division of the Indiana Department of Conservation is cooperating on the building of one structure. This will be a public recreation area.

Mr. Charles Williams, Chairman of the Board of the Washington County Soil Conservation District Supervisors, sums up the watershed program in this way: "Our farmers have been fighting these watershed problems as individuals for years and almost lost the battle. When the small watershed act was passed giving us Federal assistance and making it possible for the community to work together in attacking the problems, we soon got them whipped."

Harry Moore is assistant state conservationist for the Soil Conservation Service in Indiana. His headquarters are in Indianapolis.

EXPERIMENTAL FARMS OF PURDUE UNIVERSITY

DAN WIERSMA

OUTLYING EXPERIMENTAL farms serve as the laboratories for much of Purdue University's extensive soil and crop research program.

The Agronomy Farm serves the Botany and Plant Pathology, Entomology, and Agronomy Departments as a center for conducting soil and field crop research. The purpose of this field laboratory is to explore factors influencing the growth of various field crops, develop and test desirable findings, and make available such results to promote an improved and more profitable agriculture.

The Agronomy Farm is located 6 miles northwest of the university campus on Highway 52.

It was in the spring of 1949 that 370 acres of this farm were purchased. Prior to this time research had been conducted on the Soils and Crops Farm. One of the first steps in developing this general farm into a new experimental farm was to uniformly drain the land with a 6-inch tile every 4 rods. At present more than 300 acres of the area are tiled for intensive experimental work. About 85 staff members and graduate students are presently conducting research projects on the farm.

The Southern Indiana Forage Farm consists of 1,016 acres located approximately 15 miles southeast of French Lick in northeast Dubois County and represents the rougher part of the sandstone-shale area. The land was purchased by farmers and businessmen in the 40 southern Indiana counties and presented to the Purdue University Agricultural Experiment Station in 1952 for research purposes on soils of southern Indiana as related to forage culture. The farm is used primarily for research on establishment, production, and utilization of forage. Beef, dairy cattle and sheep are used in the forage utilization studies. The research program is developed through the Southern Indiana Forage Committee of the Experiment Station representing the interests of animal production, soil improvement and plant production, forest management, economics, biochemistry, and extension. Approximately 350 acres of land are committed to woodland management.

The Miller-Purdue Memorial Farm consists of 700 acres on the east side of Grant County and was given to the university in 1938 by I. M. Miller as a memorial to his father and mother. The research on this farm consists of grazing studies on both permanent pastures and legume-grass mixtures, supplemental feeding on pasture, and the influence of stocking rate upon pasture output. Studies of woodland management are also being conducted. The oldest stand of Birdsfoot trefoil in Indiana is located on this farm.

Purdue Sand Experimental Field is located in north central Indiana about 5 miles southwest of Culver. The Experimental Field was originated in 1921 from interest developed by the local people for a management and fertility program on the sandy soils of the area.

The soil type is a Coloma loamy fine sand, which has a very low water holding capacity, is low in nitrogen and potassium and subject to serious wind erosion during the spring of the year. Crop rotations, fertility, and varieties were studied until 1954. The information from this early work has been published and is being used by the farmers in the area.

Since 1954, the research emphasis has been on irrigation. Facilities have been installed to irrigate the entire field and research is being conducted to determine the crop response to irrigation on the coarse textured soils of Indiana.

At this farm experimental work is conducted on corn and sorghum varieties, alfalfa fertility and insect control, factors affecting maximum corn yield, response of corn to nitrogen fertilizer, environmental factors affecting water use, and critical stages of water stress on corn.

Soil Conservation Society members wishing to stop at the experimental farms to see the work being done will find resident managers happy to explain the work to them.

Dan Wiersma is professor of agronomy at Purdue University, West Lafayette, Indiana.

RAINULATOR

EROSION research information is being supplied more speedily and efficiently by the "rainulator" recently recently developed by U.S. Department of Agriculture research scientists at Purdue University. The rainulator applies high-energy simulated rainstorms to groups of field runoff plots. The resulting soil loss, runoff, and infiltration of the various conditions being compared are determined with associated research equipment. The rainulator is completely portable so studies can be conducted wherever and whenever rainstorms are desired.

The runoff and erosion control features of many farming practices and conditions can now be evaluated within a few years instead of the 10 to 25 years often required with natural rainfall. Studies which have been conducted with the rainulator include comparisons of (1) conventional, mulch, and minimum tillage, (2) shredded and unshredded crop residues, (3) various rates of surface mulch, (4) cultivation and no cultivation of crusted soils, and (5) various crop rotations. Additional studies of the effects of soil type, soil physical properties, length of slope, and steepness of slope on runoff and erosion are planned.

Progress Toward a Home for SCSA

▸ *Timing of construction waits only upon the financial resources necessary to erect this permanent home for the Society. The goal of starting construction this year can be achieved.*

▸ *Send your personal contribution today! Use the pledge form you recently received with your annual election ballot! Encourage another friend of natural renewable resource conservation to make a pledge!*

Building Fund Report – May 1, 1961

Chapter	Chapter Pledge	Individual Unpaid Pledges	Paid to Date	Other Evidence of Support
Great Plains Region				
El Paso County *(Colo.)*	$ 250	$	$ 280.00	
Ark. River Bend *(Kans.)*	320		107.10	(1) (2)
Bluestem Hills *(Kans.)*		24	31.00	
Bob White *(Kans.)*			20.00	
Fort Hays *(Kans.)*			22.00	
High Plains *(Kans.)*		8	51.65	
Manhattan *(Kans.)*	1,000	90	257.00	(2)
Pony Express *(Kans.)*			164.39	(1)
Salina *(Kans.)*			70.50	(2)
Santa Fe Trail *(Kans.)*			10.00	
Bozeman *(Mont.)*		20	54.00	
Blue-Nemaha *(Nebr.)*			10.00	
Lincoln *(Nebr.)*			166.00	(1)
Northeast Nebraska			39.00	
S. C. Nebraska		81	187.00	(2)
Southwest Nebraska			16.00	
Rio Grande *(N. Mex.)*	75		130.00	
Border *(N. Dak.)*			15.00	
Custer *(N. Dak.)*		4	209.63	
Big Hunt *(Okla.)*			22.25	
Central Oklahoma		8	35.00	
E. C. Oklahoma			102.25	
N. E. Oklahoma		8	202.32	
Northwest Oklahoma			4.00	
S. C. Oklahoma	100		58.00	
Southeast Oklahoma			13.50	
Southwest Oklahoma		8	102.00	
Stillwater *(Okla.)*			55.50	(2)
South Dakota		35	1,213.25	
East Texas	250	73	166.50	(2)
Heart of Texas		10	732.41	
North Texas		8	125.50	(1)
Wyoming		24	66.00	
North Central Region				
Egyptian *(Ill.)*	250		71.00	(2)
Northern Illinois	2,600	484	676.70	(2)
Hoosier *(Ind.)*			415.75	(1) (2)
Iowa	5,000		2,682.25	(2)
Blue Grass *(Ky.)*		8	55.00	(2)
Green River *(Ky.)*			50.00	
Kentucky Lake	250		71.50	(2)
Lake Cumberland *(Ky.)*			30.00	
Northern Kentucky			25.00	
Upper Kentucky River *(Ky.)*			40.00	(1)
Michigan	2,500	317	488.75	(1) (2)
Minnesota	1,600	113	464.75	(2)
Show-Me *(Mo.)*			222.00	
All Ohio	1,000		419.50	(1) (2)
Wisconsin	2,400	32	506.00	(1) (2)
Northeastern Region				
S. New England *(Conn.-Mass.-R. I.)*		24	61.00	(1)
Washington, D. C.	5,000	2,796	2,056.42	(2)
N. New England *(Maine-N. H.-Vt.)*	1,480		103.50	(1) (2)
Old Line *(Md.)*	1,500		552.00	(2)
Pocomoke *(Md.)*			90.00	(1) (2)
New Jersey	1,250	28	1,150.50	(2)
Empire State *(N. Y.)*	2,000	24	1,173.00	(2)
Keystone *(Pa.)*	1,000	16	223.00	(2)
Wm. Penn *(Pa.-Del.)*	400	40	376.50	(2)
Virginia	2,500	68	948.50	(2)
West Virginia	3,000	710	2,221.50	(2)
Southeastern Region				
North Alabama		20	25.00	
South Alabama			188.50	(1)
Central Arkansas	800	8	73.00	
Ozark Mt. *(Ark.)*			95.00	
Florida		268	327.00	(1)
Georgia	5,000	28	523.00	(2)
Louisiana			159.00	
Mississippi		68	44.00	
North Carolina	5,000		605.00	(1) (2)
Puerto Rico			52.00	
Western Puerto Rico			10.50	
South Carolina		84	449.05	(1)
Andrew Jackson *(Tenn.)*	1,000	79	541.00	(2)
East Tennessee	900	8	92.50	(1) (2)
West Tennessee	570	14	202.75	(2)
Western Region				
Arizona		22	109.50	
California		37	1,475.25	(2)
R. N. Irving *(Idaho)*			140.50	(2)
Oregon		160	104.00	(1)
Utah		40	58.00	(2)
Inland Empire *(Wash.-Idaho)*			182.50	
Olympic View *(Wash.)*			16.50	
Canadian Region				
Ontario	1,600		1,333.00	
Other Contributions				
Korea			20.00	(1)
No Chapter Designated		80	575.50	
Development Fund Board Special Solicitation			1,000.00	
Total	$50,595	$5,977	$28,314.92	44
Interest earned			$ 204.06	
Total on deposit			$28,518.98	

(1) General Chapter Support
(2) Chapter Building Fund Committee Organized

NEWS NOTES

AGRONOMY SOCIETY NAMES STELLY

Dr. Matthias Stelly, formerly professor of soils at Louisiana State University, has been named executive secretary of the American Society of Agronomy, effective April 1. Dr. Stelly is in charge of the ASA central office which has been located in Madison, Wisconsin, since 1948. Stelly will also serve as publications director for the crop and soil research and educational journals published by the organization.

WATERSHED CONGRESS

More than 400 persons from 40 states attended the Eighth National Watershed Congress held in Tucson, Arizona, April 17-19. Informative papers and discussions on "Planning for Water Use," "Multiple Use of Watersheds," and "Water for a Thirsty Land" were presented by leading authorities.

Named as "Watershed Man of the Year" by the Congress was John S. Wilder, an attorney-farmer who is also president of the Tennessee Association of Soil and Water Conservation Districts.

"Watershed Project of the Year" awards went to the Mountain Run Watershed of Culpeper County, Virginia, and the Upper West Fork of Cypress Bayou Watershed in Bossier Parish, Louisiana.

The *Soil Conservation Society of America* used the occasion of the Congress to present a merit award to "Water Street U.S.A.," an educational project of the Arizona—Sonora Desert Museum and the Charles Lathrop Pack Forestry Foundation. A tour of the Desert Museum and "Water Street U.S.A." were features of the Congress program.

The Watershed Congress is not a membership organization; participating organizations, including the *Soil Conservation Society of America*, select and direct a steering committee that plans and conducts the annual meeting. The Congress is a forum for the discussion of ways and means of expediting and broadening local watershed programs.

CROP SCIENCE

Crop Science is the name of a new research journal which appeared in February 1961 as the official publication of the Crop Science Society of America, an affiliate of the American Society of Agronomy.

This new, bimonthly journal will carry research reports on breeding, genetics, physiology, ecology, and management of field crops, pastures, ranges, and turfgrasses from crop scientists.

Crop Science will be a companion publication to Agronomy Journal, the official organ of the American Society of Agronomy. It will alternate publication dates with the Journal and will carry the articles formerly published in the Journal of direct interest to workers in the above mentioned areas of research. Agronomy Journal will continue to carry the articles of wider agronomic scope.

Dr. I. J. Johnson has been named as editor of the new publication and Dr. Harry L. Hamilton will serve as managing editor.

Russell Hill (left), past president of the Society, presents Merit Award plaque at the National Watershed Congress to "Water Street U.S.A." The award is being accepted by Arthur N. Pack, president of the Arizona-Sonora Desert Museum.

GOODYEAR ANNOUNCES SOIL CONSERVATION PROGRAM

The Goodyear Tire & Rubber Company recently announced details for the ninth nationwide Soil Conservation Awards Program. The contest will run for 12 months, beginning May 1, 1961, and closing April 30, 1962.

A. H. Settle, director of the program for Goodyear, indicates that announcements and enrollment forms have been mailed to all Soil Conservation Districts.

The major objective of the program is to provide each district governing body with a means of measuring their achievements during the contest period. Points are earned based on the district's accomplishments as compared to their yearly plan of work.

SOIL AND WATER CONSERVATION RESEARCH REORGANIZATION

Cecil H. Wadleigh, director of the Soil and Water Conservation Research Division of the Agricultural Research Service, U. S. Department of Agriculture, has recently announced a reorganization of that division effective March 27. The division is now organized on the basis of seven regional branches in lieu of those previously existing. The branch chief in each area is administratively responsible for the total division program in his area.

Northeastern Branch: W. W. Pate, chief. C. S. Britt, assistant chief. (Maine, N. H., Vt., Mass., R.I., Conn., N. Y., N. J., Pa., W. Va., Md., Va., Del.)

Southern Branch: Russell Woodburn, chief. (N. C., S. C., Ga., Fla., Ala., Miss., La., Ark., Tenn., P. R.)

Cornbelt Branch: C. A. Van Doren, chief. (Minn., Iowa, Mo., Wis., Ill., Mich., Ind., Ohio, Ky.)

Northern Plains Branch: Omer J. Kelley, chief. Fred Strauch, assistant chief. (Mont., Wyo., Colo., Nebr., S. Dak., N. Dak.)

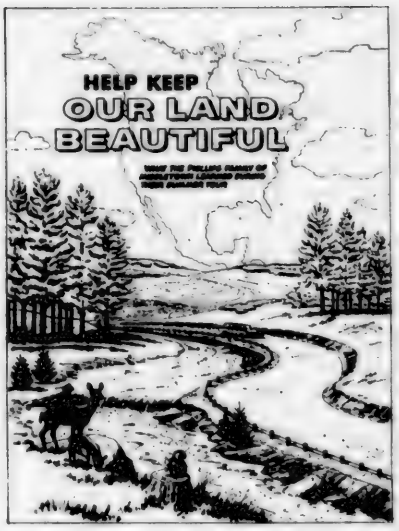
Southern Plains Branch: J. R. Johnson, chief. (Kans., Okla., Texas, N. Mex.)

Southwestern Branch: C. E. Evans, chief. (Ariz., Calif., Nev., Utah, Hawaii.)

Northwestern Branch: J. S. Robbins, chief. (Idaho, Oregon, Wash., Alaska).

GEOLOGIC MAPPING

A new program of cooperative geologic mapping by the State of Kentucky and the Geological Survey, Department of the Interior, is planned to cover the entire State within about 10 years at an approximate cost of $12 million.



"Help Keep Our Land Beautiful," the *Society's* newest popular type publication has received wide acceptance and more than 100,000 copies have been purchased since it was printed in mid-March.

Comments have been received from *Society* members and friends. David B. Webster, Managing Director, Federation of Ontario Naturalists, Don Mills, Ontario, wrote, "We were most interested in seeing your booklet entitled 'Help Keep Our Land Beautiful.' I particularly liked the approach to the problem and the way in which you are stressing some of the solutions in an entirely palatable manner."

George D. Scarseth, Director of Research, American Farm Research Association, West Lafayette, Indiana, wrote, *"The Soil Conservation Society of America* is to be commended for its fine educational effort in bringing out the booklet 'Help Keep Our Land Beautiful.' It is an attractive educational pamphlet and I hope it is widely used, especially in our schools." Scarseth, well known to *Society* members, philosophized, "Land dies so slowly, and there is no drama in its dying—the drama comes in the tragedy that follows after the land is dead."

Orders for 1,000 or more copies of "Help Keep Our Land Beautiful" have been secured, as of May 1, 1961, from the following:

1,500—Spink Co. SCD, *Redfield, S. Dak.*
1,000—E. A. Owen, *Somerville, Tenn.*
5,000—SCS, *Washington, D. C.*
1,000—Miner Co. SCD, *Howard, S. Dak.*
1,000—Standing Rock Tribal Cons. Service, *Fort Yates, N. Dak.*
1,000—Willard A. Hamm, *Eau Claire, Wis.*
1,000—State Soil Cons. Comm., *Madison, Wis.*
2,000—Texas Co. SCD, *Guymon, Okla.*
1,000—SCS, *Spokane, Wash.*
1,000—Ray T. Lynge, *Urbana, Ill.*
1,000—Tuscola SCD, *Caro, Mich.*
1,000—Reserve SCD, *Plentywood, Mont.*
1,000—West End SCD, *Cucamonga, Calif.*
1,000—Washington Co. SCD, *Washington, Pa.*
1,000—Scotts Bluff SCD, *Scottsbluff, Nebr.*
1,000—Metropolitan Toronto Cons. Auth., *Woodbridge, Ont.*
2,000—Ogeechee River SCD, *Statesboro, Ga.*
1,500—North East SCD, *Winnsboro, La.*
1,500—Greer Co. S. & W.D., *Mangum, Okla.*
1,000—Orangeburg SCD, *Orangeburg, S. C.*
2,000—Coachella Valley SCD, *Coachella, Calif.*
1,000—SCS, *Charlotte, N. C.*
1,000—Knox SCD, *Mt. Vernon, Ohio*
2,000—Remington Arms Co., *Bridgeport, Conn.*
3,000—Cuyahoga SCD, *Strongville, Ohio*
10,000—Department of Natural Resources, *Columbus, Ohio*
1,000—Stutsman Co. SCD, *Jamestown, N. Dak.*
1,200—Ottauquechee SCD, *Woodstock, Vt.*
5,000—Otter Creek Cons. Auth., *Simcoe, Ont.*
1,000—Stevens Co. SCD, *Hugoton, Kans.*
1,000—Western Mora SCD, *Mora, N. Mex.*
1,000—SCD Directors, *Pittsburgh, Pa.*
1,000—Univ. of Md., *College Park, Md.*
1,000—Holmes SCD, *Millerbury, Ohio*
1,500—State Soil Cons. Comm., *Athens, Ga.*
1,325—Marshall Co. SCD, *Britton, S. Dak.*
1,000—State Fish and Game Dept., *Helena, Mont.*
1,000—Lawrence Co. SCD, *Bedford, Ind.*

STOCK TANK #1 on the Cole Ranch 30 miles Northeast of Phoenix, Arizona, was treated with SS-13 on October 23, 1959. Tank contained 200,000 gallons of water to which 200 gallons of SS-13 were added. A 75% reduction in seepage was achieved. Tank dried up May 15, 1960; remained dry until August 23rd. Tank refilled by rain on August 25. Measurements showed 75% seal still intact.

STOCK TANK FILLS, DRIES, FILLS AGAIN SS-13 SEAL STILL STOPS 75% OF SEEPAGE

Carefully-controlled tests over a two year period show that stock tanks treated with SOIL SEALER -13 (SS-13) can dry out completely and remain dry for months at a time and only an insignificant percentage of the effectiveness of the treatment is lost. The SS-13 seal also is unaffected by cattle walking over the bottom of the tank as the water level falls.

SS-13 is a liquid chemical compound designed primarily for application to sandy, alkaline soils which still leak after maximum compaction under field conditions. Applied properly, SS-13 reduces water loss through seepage by from 60% to 90% in earth reservoirs such as stock tanks and irrigation canals.

SS-13 is approved for the Agricultural Conservation Program Service of Arizona. It is harmless to animals and humans, but, while in solution, is harmful to fish.

FOR ADDITIONAL INFORMATION AND EXPERIENCE DATA FILL OUT AND MAIL THE COUPON BELOW.

SS-13

SALES COMPANY
P.O. BOX 4425 • PHOENIX, ARIZONA

Please send me more data concerning Soil Sealer-13 with special reference to its use in.....

.....

Name .....

Address .....

City..... *State* .....

NEWS OF MEMBERS

Dr. E. T. York, long-time member of the *Society*, was recently appointed as the Administrator of the Federal Extension Service. Since May, 1959, Dr. York has been director of the Alabama Extension Service. He is a graduate of Auburn University and received his doctoral degree from Cornell University in 1949. From 1953 to 1956 Dr. York was head of the agronomy department at North Carolina State College and thereafter was eastern director of the American Potash Institute until going to Alabama in 1959.

Richard E. McArdle, Chief, Forest Service, U. S. Department of Agriculture, has been named as one of six outstanding career civil servants to receive the 1960-1961 Rockefeller Public Service Awards. In addition to receiving a $3,500 cash award, each winner is also privileged, if he so desires, to devote some time to lecturing, writing, conducting a research program at a university of his choice, or engaging in some other educational endeavor. The awards permit additional grants on which the winners may draw to allow fulfillment of their projects.

Paul A. Herbert, East Lansing, Michigan, has been elected president of the National Wildlife Federation. Dr. Herbert is Chief of Research of the Michigan Department of Economic Development and before assuming that post was Director of Conservation at Michigan State University.

A. Forrest Sorensen has returned to the U.S. from Ghana where he served for 2 years with the International Cooperation Administration. Sorensen's chief duties while in Ghana were to supervise the installation of fresh water ponds that would provide an adequate water supply during the dry seasons.

Richard Kilbourne, head of the Tennessee Valley Authority's forestry program since 1954, has been named to head the new TVA Tributary Area Development Office which will coordinate that agency's increased emphasis on achieving better use of resources in tributary areas of the Tennessee Valley. **Kenneth J. Seigworth** was appointed to the position of Director of the Division of Forestry Relations for TVA when Kilbourne moved to his new post. Seigworth has been Chief of the Forest Development Branch since 1942.

George S. Eason, with the International Voluntary Services, U.S.O.M. and stationed in Phnom-Penh, Cambodia, is currently directing work on one of the major projects of American aid to Cambodia. The station development is 2,000 hectares in size and most of it is dense jungle. A station nursery, about 2 hectares in size, is being developed and a sprinkler irrigation system is being used to propagate grasses and legumes as well as experiment with new varieties. An extensive building construction program is also being undertaken.

Horace J. Harper, member of the JOURNAL's editorial board, and professor of soils at Oklahoma State University has accepted a 2-year appointment to foreign agricultural service. He will serve as soils specialist in charge of teaching and research on the staff of Ataturk University, Erzurum, Turkey. Dr. Harper left New York by plane on April 26; his wife will join him in mid-June. Ataturk University was established in 1957 by the Turkish Ministry of Education and is patterned after land-grant agricultural colleges in the U. S.

Walter P. Taylor of Claremont, California, is the recipient of the Aldo Leopold Memorial Award Medal given in recognition of "distinguished service and outstanding accomplishment in the cause of conservation." The award is given by the Wildlife Society and was presented to Taylor at the annual banquet of the North American Wildlife and Natural Resources Conference held in Washington, D. C. in early March.

George S. James, formerly in charge of the U.S. Forest Service public information programs in the 11 southern States, has been named as deputy to Assistant Forest Service Chief, A. W. Greeley. James will be in charge of the nationwide programs of National Forest Protection and Development which include fire control, engineering, and land adjustments and classification.

HAVE YOU CONSIDERED?
A Bequest to the Soil Conservation Society of America

Members and friends of the Society who find it impractical to make substantial contributions to its important activities during their lifetime might consider gifts in the form of a bequest.

The Society qualifies under Internal Revenue Service codes as a nonprofit organization and gifts to it are not taxable. Write to the Executive Secretary for further information on the tax status of the Society. He will also, with the assistance of the Society's legal counsel, help you draft a suitable bequest paragraph for incorporation in your will. Officers of the Society stand ready at all times to counsel with those who wish to know more about designating gifts in this way.

Soil Conservation Society of America
838 Fifth Avenue
Des Moines 14, Iowa

Dr. and Mrs. Austin Patrick are now visiting in Europe. They plan to return to the United States in June.

John Loucks has resigned his position as area conservationist with the Soil Conservation Service to become associated with the Bober Seed Company. He will continue to make his home in Rapid City, South Dakota.

John Lamb, Venice Center, N. Y., a member of the JOURNAL's editorial board, is recovering nicely from a recent serious operation.

Adrian C. Fox will represent the *Society* at the 1961 annual meeting of the Conservation Education Association. Fox is a member of the *Society's* Conservation Education Committee.

George Free's report on "Minimum Tillage for Soil and Water Conservation" has been translated into Spanish and Portuguese and will be distributed in Latin America.

CHAPTER NEWS

Minnesota Chapter reports that all records for attendance at chapter meetings were broken when 196 individuals registered for the annual meeting on January 11. The outstanding program on rural zoning attracted, among others 49 County Commissioners, 21 Soil Conservation District Supervisors, 7 County engineers, 11 city and urban planning associates, a mayor and a county auditor.

Dr. Richard Rust of the University of Minnesota presented a paper on the application of soil surveys in rural zoning. He indicated that soil scientists in Illinois have recently cooperated with the Northern Illinois Metropolitan Area Planning Commission and in the study prepared for the Commission, soils units were grouped into soil resources areas with the suitability of these areas estimated for major uses, i.e., agriculture, residence-subdivision type, residence-estate type, industry, recreation, and transportation.

"It is generally believed that zoning is used chiefly to prevent bad things from happening," stated Guy Kelnhofer of the Minnesota Department of Business Development, in another presentation. "While zoning has its restrictive features, a good ordinance actually seeks to encourage the best use of land," he added.

William H. Kircher, editor-in-chief of *The Farmer* magazine, was the after dinner speaker. Elected as Chapter chairman for the coming year was Matt Thorfinnson, while Gerald Simpson was named vice chairman and H. L. Thomas was elected secretary-treasurer.

Hugh Dowdle, chapter president, introduced the banquet speaker, Remo Molinaroli. Mr. Molinaroli, an engineer with the Soil Conservation Service, presented an illustrated talk concerning his recent European trip and stressed particularly the agricultural water management schemes there.

On Saturday morning chapter members were guests of the Charleston Soil Conservation District on a boat tour of the Charleston harbor and historic Fort Sumter.

West Virginia Chapter—Some 40 youngsters, children of the members of Area II of the chapter aided the cause of conservation on April 15. The children planted 125 conifers on a plot of ground allotted to them by the superintendent of the beautiful Tygart Lake State Park near Grafton.

Each tree was tagged with the name of the child who planted it and a permanent record of this will be kept in the chapter archives so that through the coming years, as the children grow they can watch their own very special tree mature.

The outing was complete with a picnic and the crowning of a Paul Bunyan and his Lady. Two *Society* members from the U.S. Forest Service were planting guides. During the day Smokey Bear paid the group a visit and entertained the crowd.

Hoosier Chapter (Indiana)—Is BUSY!

California Chapter members held their annual meeting in San Jose in conjunction with the annual convention of the California Association of Soil Conservation Districts on January 18.

SCS Photo by Leadbetter

Another attractive exhibit at the West Virginia Chapter meeting tells its own story. Each of the seven chapter areas constructed an exhibit for the annual meeting.

The chapter's highest honor, the Distinguished Service Award, was presented to John Barnes and Harry Blaney. Dr. Walter Lowdermilk presented, "The Role of the Soil Conservationist in the Fabulous Fifteen Years Ahead."

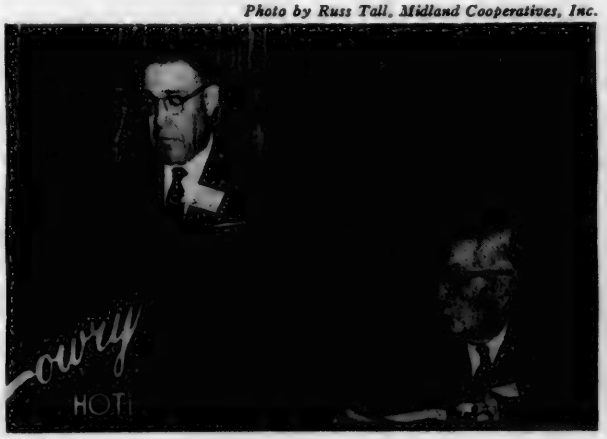
Two California Chapter members, Frank Brooks and R. Earl Storie are now in Spain helping determine the feasibility of an irrigation project there.

On March 9 the San Diego Section of the chapter held a meeting at Escondido and on March 10 the executive council of the chapter held a meeting there to further plan the chapter's 1961 activity program.

South Carolina Chapter members met in Charleston on March 24 and 25. The entire group enjoyed a party at the home of Mr. and Mrs. T. Wilbur Thornhill prior to the excellent annual banquet.

W. A. Rowlands speaks at Minnesota Chapter Meeting. Discussion moderator, Harold Macy, is seated.

Photo by Russ Tall, Midland Cooperatives, Inc.



Georgia SCSA Chapter leaders got a jump on the new year when they met in Watkinsville December 9 to plan the Chapter's spring meeting. The meeting date is set for May 26-27 at Rock Eagle Park near Eatonton. As usual, it will be a family affair with a planned program for wives and youngsters. Seated (left to right) are Dr. G. G. Williams, program chairman; A. D. Searcy and C. C. Chapman. Standing (left to right) are W. E. Adams, chapter secretary; J. C. Owens; D. C. Craig; Cecil Clapp, chapter president; and Jack Bennett.

U. S. Forest Service Photo

East Central Chapter (Oklahoma) completed a 1960 summer project which consisted of placing 35 tree and grass identification signs along a popular hiking trail in Robber's Cave State Park, at Wilburton, Oklahoma.

The hiking trail is located in the northern section of the park and leads to Robber's Cave, a supposedly historic hide-out once used by Belle Starr, the Dalton brothers, and other notorious outlaws.

Lem Ball, Bill Fountain, Bill Eddings and Charles Herndon, the four members most responsible for completion of the project, are proud of the fact that the total cost of the project to the chapter amounted to only $13.49. Part of the materials were furnished by interested organizations.

Identification signs were made by using rectangular pieces of 24-gauge sheet metal for the name plates. Posts were made from used oil field sucker rods. Names of the trees and grasses were placed on the name plates with black paint, after first providing a white painted background. Where possible, signs were set in concrete for permanency.

East Central Oklahoma Chapter members Bill Eddings (left), Charles Herndon and Bill Fountain examine one of the completed markers they helped to place on a nature trail in an Oklahoma state park.

Bureau of Indian Affairs Photo

Upon completion of the project, a dedication supper was held at the park restaurant at which time all Chapter members had the opportunity to make the approximately one-hour nature trail tour. Following the tour and supper, a conservation talk was given by Dr. Lloyd E. Church, *Society* member from Wilburton.

Pony Express Chapter (Kansas)—On March 1 a chapter council meeting was held and decisions made to hold an annual "Stag Party" in April, and a family type meeting during June.

Virginia Chapter—The first chapter newsletter to be issued came from the presses recently. It was full of information and certainly should provide an excellent communications media for the chapter.

NEW CONTROLS FOR AQUATIC VEGETATION

NARROWLEAF (monocot)

"CHEM-SEN 56"

- For submerged and emergent narrowleaf
- Heavy liquid herbicide
- Compounded to obtain maximum mixing with water
- Equal distribution throughout specified area. Will not drift except in very heavy current
- Applied during early part of summer for maximum effectiveness
- Broad spectrum weed killer effective against algae
- Use hydraulic sprayer at 40-50 lbs. of pressure
- Averages 1½ gals. per 70,000 cubic feet (length x width x depth)

BROADLEAF (dicot)

"CHEM PELS 2,4-D"

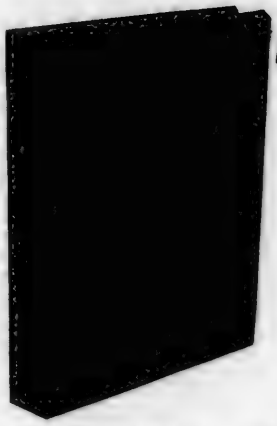
- For submerged and emergent broadleaf
- Pelletized herbicide
- Not affected by water dilution depth or flow
- Slow, regulated toxicant release to plant intake
- Residual lethal concentrations for one to three years
- Non-toxic to humans, animals, fish or aquatic organisms
- No special equipment needed
- Applied at the rate of 100 to 150 lbs. per acre

Free Field Biologist Services Available—Technical Data Reports on Request

CHEMICAL INSECTICIDE CORPORATION

30 WHITMAN AVENUE **METUCHEN, NEW JERSEY**

Agricultural Chemicals • Insecticides • Weed Killers • Wood Preservatives • Fungicides • Rotenticides



Keep Your Copies of the JOURNAL Together and Protected

You probably keep most of your Journals now. They hold such a wealth of information. But how irritating to look for a particular issue and not be able to locate it.

This fine, sturdily constructed binder, bound in dark green with gold leaf lettering, will hold two complete volumes of the magazine.

Copies can be inserted, one at a time, simply by the snap of a flat metal blade. This binder will preserve your magazines—no tearing, creasing and fraying of copies you want to save.

Order your binder today! $2.75 postpaid.

Soil Conservation Society of America
838 Fifth Avenue, Des Moines 14, Iowa

Keep valuable acreage in full production...

BERMIDRAIN

If land drainage or reclamation is your problem, look into BERMIDRAIN fibre pipe systems as the lower cost, longer lasting solution.

Bermico BERMIDRAIN pipe is cellulose fibre sealed with special bituminous pitch that resists acid, alkaline soils, and corrosion. Longer, lighter-weight sections of Bermico are so easily fitted and installed that labor savings are substantial. And BERMIDRAIN always maintains grade and alignment once installed . . . S.C.S. approved perforations permit maximum infiltration without silting. With BERMIDRAIN — you install it and forget it. See your nearest dealer for full details.

BERMICO

Another Quality Product of

BROWN COMPANY

General Sales Offices: 150 Causeway Street, Boston 14, Mass.
Mills: Berlin, New Hampshire
Birmingham, Alabama • Corvallis, Oregon

Gilbert Bierwagen (left) of the **South Dakota Chapter** presents the chapter's Senior Conservation Award to Cecil Haight during the recognition banquet held on February 7 as a part of the chapter's annual meeting. On the right is Marvin Strachan, 1960 chapter president. Haight, a biology instructor and chairman of the Science and Mathematics Division, Black Hills Teachers College, Spearfish, has developed a two week conservation short course for elementary school teachers. This summer session involves field trips and classroom work. Many soil conservation districts furnish scholarships so that teachers may attend. In his award acceptance speech Haight said, . . . "In order that we may develop these resources fully and fairly for each of our contemporary users, and still guarantee a sufficiency for future generations, we all, as individuals and as groups, must be willing to see the other fellow's side of the [resource-use] picture."

Tuskegee Institute Student Chapter—The *SCSA* Council has approved a charter for a new student chapter at Tuskegee Institute, Tuskegee, Alabama. William H. Farley, head of the agronomy department at Tuskegee is the chapter's advisor. He indicated recently that a charter night meeting is being planned.

Rutgers Student Chapter (New Brunswick, N. J.) was host to nine agronomy students and their faculty advisor from Virginia on March 24 and 25. A social hour was arranged for the visitors by Rutgers Student Chapter members; a tour of the Microbiological Institute of Rutgers University was on the agenda for the Virginia group. A film, "From a Handful of Soil," which tells the story of the discovery of streptomycin by Dr. Selman Waksman, was shown as a part of the Institute tour.

The Rutgers students housed their guests in a local fraternity on the evening of the 24th, and during the next morning a tour of the Rutgers University Soils and Crops Departments was held. Dr. John Pendleton is advisor for the Virginia group and accompanied them on the Rutgers visit.

Puerto Rico Student Chapter.—Seventeen students at the University of Puerto Rico, College of Agriculture, Mayagues, Puerto Rico, have organized a student chapter of the *Society*.

Chairman of the student group is Jose A. Avalo. Faculty advisor is Roberto Chevres, assistant professor of agronomy at the University and a member of the Western Puerto Rico Chapter *SCSA*.

Harry Chambers, former Council member, and now head of the Soil Conservation Service in the Carribean area, presented the charter to the new student group in a meeting on the campus, April 14, 1961.

Students from throughout Latin America are enrolled at the University of Puerto Rico and the organization of a student chapter is expected to strengthen the *Society* in other countries.

SNOW
CAST IRON KANAL GATES
☆
They Last Longer
"PARKERIZED" to Resist Rust

Manufacturers of Low Pressure Gates and Valves for Irrigation in various types in all sizes from 6" to 72"

SNOW GATES & VALVES
2437 East 24th Street
P. O. Box 3369 • Los Angeles 54, California

JOURNAL OF SOIL AND WATER CONSERVATION

BACK ISSUES AVAILABLE

Volume	*Year*	*Numbers*	*Price per Volume*	*Price Per Copy*
I	1946	1, 2	$1.75	$ .90
II	1947	1, 2, 3, 4	3.00	.75
III	1948	1, 2, 3, 4	3.00	.75
IV	1949	1, 2, 3, 4	3.00	.75
V*	1950	3, 4	1.50	.75
VI	1951	1, 2, 3, 4	3.00	.75
VII	1952	1, 2, 3, 4, 5	3.00	.75
VIII*	1953	1, 3, 4, 5, 6	3.00	.75
IX*	1954	1, 2, 3, 4, 5	3.00	.75
X	1955	1, 2, 3, 4, 5, 6	5.00	.85
XI	1956	1, 2, 3, 4, 5, 6	5.00	.85
XII*	1957	2, 3, 4, 5, 6	5.00	.85
XIII	1958	1, 2, 3, 4, 5, 6	5.00	.85
XIV*	1959	1, 2, 4, 5, 6	5.00	.85
XV	1960	1, 2, 3, 4, 5, 6	6.00	1.00

*Out of print: Vol. V, No. 1 and 2; Vol. VIII, No. 2; Vol. IX, No. 6; Vol. XII, No. 1; Vol. XIV, No. 3.

The Society will pay $1.00 an issue for numbers out of print if they are in good condition.

Order back issues from:

Soil Conservation Society of America
838 Fifth Avenue
Des Moines 14, Iowa

Wisconsin Chapter. The Milwaukee Art Center was the site of an excellent annual meeting on January 13. Under the direction of program chairman Al Richey, a profitable day was organized for the nearly 100 persons attending.

Professor Peter Dorner presented a paper titled, "Technological Revolution in Agriculture," and Dr. Sidney Wietzman talked about "Challenges and Advances in Forestry."

Manhattan Chapter (Kansas)—Chairman Merton Otto presided over the spring dinner meeting attended by chapter members and their wives at Clay Center on March 31. A chapter pledge was made toward the *Society's* building fund and a report was received concerning plans made for inviting the *Society* to hold its annual meeting at Kansas State University in 1966. George Halazon of the University gave an illustrated talk on wildlife and wilderness.

Oregon Chapter recently issued an excellent newsletter setting forth duties, responsibilities and goals of chapter committees and appointees for 1961.

THE EDITOR'S MAIL

(Continued from page 104)

The March-April issue of the JOURNAL *of* SOIL AND WATER CONSERVATION *carried a thought provoking article, "Aspects of Conservation—Political, Social, Economic," by A. Allan Schmid. J. Ralph Sasser, a member of the Editorial Board for the* JOURNAL, *was asked by the editor to review Professor Schmid's paper and that review was transmitted in the letter reprinted above. Mr. Sasser is a long-time member of the Society and has had professional experience both in the technical and administrative areas of resource use and conservation. He is currently serving as state conservationist with the Soil Conservation Service in Tennessee. Sasser's comments do not, of course, represent the official views of the Soil Conservation Service.*

—EDITOR

The January-February issue of the JOURNAL *carried a review of the book, The Meaning of Wilderness to Science (pp. 29-30). Copies of the correspondence exchange which ensued between the editor of the book and the reviewer crossed the* JOURNAL *editor's desk. With the kind permission of the writers and believing this correspondence most informative the letters are reproduced here.*

—EDITOR

February 6, 1961

Dear Bernie:

I was quite surprised to read the poke you took at me and wonder why. I know my teen-agers must consider some of the things I do to be senseless but this is the first time it has been applied in print! Wouldn't it have been more helpful, rather than use the word "senseless," to point out where—if anywhere—the kind of research was carried out that should put my questions at ease, and why the validity of its results are beyond question by anyone? What, for example, did your division publish on the Barr report on the stripping of watersheds in Arizona?

I don't understand your allusion to the the millions of acres in crops already and the relation of that to forest land. As I understand it, we have 600 million acres of forest land and 400 million of land put to agriculture, very much of it being land that is so level that there is no substantial erosional problem other than from wind. What was done on comparatively gentle agricultural slopes may not be too relevant to what is planned for steep forested land.

In the face of the criticism of logging

practices and their detrimental effect on reservoirs—criticism not by Brower but by the Corps of Engineers and other dam-building experts—how can you be quite so sure that everything is all right in all the watershed studies? What has been done toward studies of the entire ecosystem at Coweeta or Dimas or anywhere?

I fully realize that the final answer will never be in on anything. But have we even started getting the first adequate answers on some of these questions?

I note that after a good many decades of snorting at the lay critic, foresters themselves are concerned now about some of the deleterious effects of monoculture. Considering the rapidity of change in all scientific research and the newness of watershed studies, maybe it is true that "if science teaches us anything, it teaches us that yesterday's smugness may become today's doubt and the butt of laughter for tomorrow."

I'm sorry you didn't comment on the significant parts of the Foreword, which quite a few people have thought to be important. The question of future recreational impact from the sheer weight of numbers is a monstrous one—but rendered comparatively insignificant by the overwhelmingly greater impact now being perpetrated by preclusive use—by loggers, logging roads, and behemoth logging equipment. I am inclined to agree with Martin Litton's observation that present-day logging methods are far more destructive of forest soils than the old high-lead, logging-railroad method was.

So let's step outside and take off our coats! With all best wishes anyhow.

With all best wishes anyhow.

—DAVID BROWER, Executive Director
Sierra Club

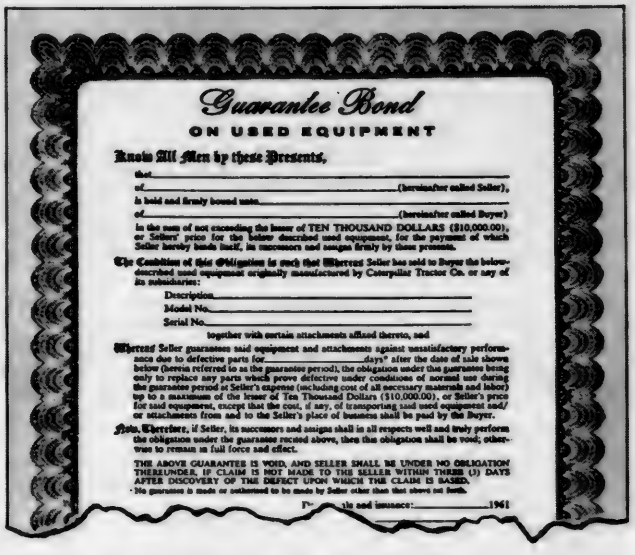
Dear Dave: February 17, 1961

My objections to your statements in *The Meaning of Wilderness to Science* are based upon quite different reasons than you attempt to assign to me in your respective letters of February 6 to Editor Jeske and to me. Here are some of the reasons:

1. You fail to make a clear-cut distinction between research personnel and their scientific activities on the one hand, and the policies and practices of timberland owners, public or private, on the other hand.
2. Under the heading *"The San Dimas Experiments"* (page 44) you abstract certain limited phases of the work from the overall program and then you criticize that program for not being farsighted or balanced! Under that same heading you say, "Perhaps

(Continued on page 152)

This Bond Is an Investment in You



Guarantee Bond

ON USED EQUIPMENT

Know All Men by these Presents,

that _____

of _____ (herein/after called Seller),

is held and firmly bound unto _____

of _____ (herein/after called Buyer)

in the sum of not exceeding the lesser of TEN THOUSAND DOLLARS ($10,000.00), or Sellers' price for the below described used equipment, for the payment of which Seller hereby binds itself, its successors and assigns firmly by these presents.

The Condition of this Obligation is such that Whereas Seller has sold to Buyer the below-described used equipment originally manufactured by Caterpillar Tractor Co. or any of its subsidiaries:

Description _____

Model No. _____

Serial No. _____

together with certain attachments affixed thereto, and

Whereas Seller guarantees said equipment and attachments against unsatisfactory performance due to defective parts for _____ days* after the date of sale shown below (herein referred to as the guarantee period), the obligation under this guarantee being only to replace any parts which prove defective under conditions of normal use during the guarantee period at Seller's expense (excluding cost of all necessary materials and labor) up to a maximum of the lesser of Ten Thousand Dollars ($10,000.00), or Seller's price for said equipment, except that the cost, if any, of transporting said used equipment and/or attachments from and to the Seller's place of business shall be paid by the Buyer.

Now, Therefore, if Seller, its successors and assigns shall in all respects well and truly perform the obligation under the guarantee recited above, then this obligation shall be void; otherwise to remain in full force and effect.

THE ABOVE GUARANTEE IS VOID, AND SELLER SHALL BE UNDER NO OBLIGATION THEREUNDER, IF CLAIM IS NOT MADE TO THE SELLER WITHIN THREE (3) DAYS AFTER DISCOVERY OF THE DEFECT UPON WHICH THE CLAIM IS BASED.

No guarantee is made or authorized to be made by Seller other than that above set forth.

Executed and issued: _____ 1961

Signed by your Caterpillar Dealer, this bond gives you up to $10,000 worth of machine dependability

BONDED BUY

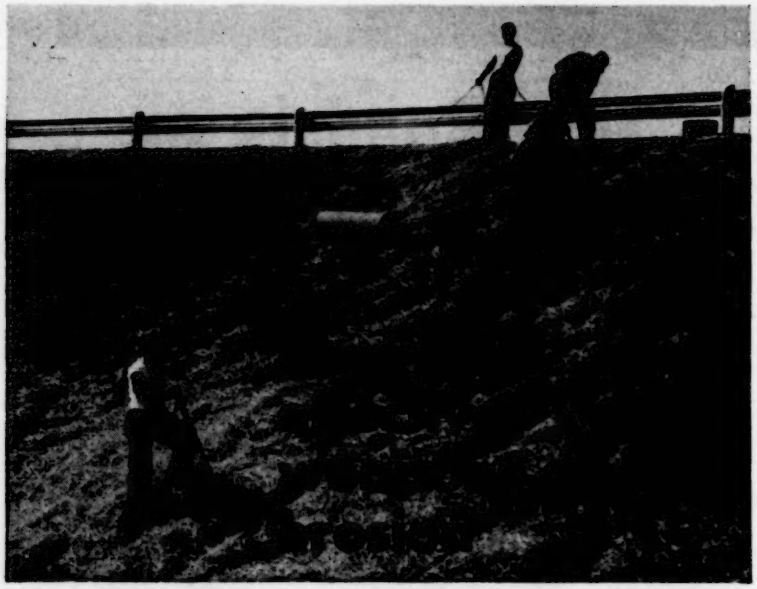
Bonded Buy means guaranteed machine dependability. You can get a completely-checked, used Cat-built machine that has the Cat Dealer's confidence and guarantee, PLUS this bond from Lumbermens Mutual Casualty Company that backs up your machine with as much as $10,000 worth of parts and labor for the period you and the dealer agree upon.

See your dealer. Read the bond. Check the details. This guarantee can apply on your next used machine. And you pay no extra premium for this assurance. Dependable Bonded-Buy machines are priced right—and your Cat Dealer offers terms to match your needs. Call him or see him soon. Do business with the man whose business is built on dependability.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.



BEMIS MULCHNET

For holding straw or other mulch on critical slopes, on forest-tree nursery beds, etc., while seeds germinate. MULCHNET is a wide-weave, twisted-paper fabric with excellent weathering qualities. Retains 50 to 75% of its tensile strength when wet. Selvage edges and center yarns (used in stapling the material in place) are mildew-treated and reinforced for longer life.

MULCHNET is surprisingly low in cost—only about 4¢ per square yard. And it's fast and easy to apply. See the stapling tool illustration.

BEMIS EROSIONET®

For use without mulch—holds seed in bed and controls erosion on slopes. A twisted-paper fabric, its closely woven, square mesh forms millions of tiny dams which hold seed and sprouting grass firmly in place. EROSIONET also catches and holds moisture, thus aiding germination. Easy to apply; hold in place with staples. Bemis has manufactured EROSIONET for soil conservation and landscaping for more than 25 years.

MULCHNET and EROSIONET are easily and quickly applied

Wire staples and stapling tool designed especially for MULCHNET and EROSIONET make application quick and easy. The tool is quickly loaded and the material is stapled without stooping.

MAIL THIS COUPON TODAY

Bemis Bro. Bag Co., 2400-C S. Second Street, St. Louis 4, Mo.

Please send test-size sample roll of
MULCHNET ☐ EROSIONET ☐

*Name*_____

*Firm*_____

*Address*_____

*City*_____ *Zone*_____ *State*_____

(Continued from page 151)

it is not fair to look to foresters for answers about the soil mechanisms when they are under such great pressure to increase the allowable annual cut of the timber resource."

Neither the organization of watershed research in the Pacific Southwest (or any other) Forest and Range Experiment Station, nor the highly varied training and backgrounds of the personnel who perform such research warrants the above statement. These scientists represent many fields besides timber forestry, they have nothing whatever to do with timber cut allocations, and the only pressure they are under is to do their work objectively and competently.

3. The watershed research program of the Forest Service is no "short-time" affair as you so plainly intimate in your statement under the heading *"Coweeta Experiments"* (page 44). You say, among other things, "the experiments should be over a long period." That program, initiated in the early thirties, was originally designed to go on for a long time and undoubtedly will continue to go on for as long a time in the foreseeable future as questions on basic plant-soil-water relations remain unanswered. Similarly, you should know that the Forest Service's watershed research at San Dimas, Coweeta and elsewhere has been deeply concerned from the very beginning with the long-time effects of various practices on soil stability. This basic principle has not been lost sight of in that current phase of experimentation which involves various methods of changing the existing vegetation to determine how water yield may be affected.

In conclusion, the fact that some people wax overly enthusiastic for all the water they can get, regardless of how muddy it comes down, etc., should sharply be differentiated from the fact of watershed research objectives, investigations and findings. Anyone can distort the results of someone else's research to suit their own presuppositions, however laudable or mercenary, as the case may be, and this practice has unfortunately been all too common in the watershed field. So let's not attack the scientists for the distortion or omissions *others* have made of their findings, nor play down the recommendations made by the scientists themselves for further studies and experiments to better understand how watersheds function.

—Bernard Frank, Professor of Watershed Management, Colorado State University

MINUTE-MOUNT MOWER FOR MEN ON THE MOVE

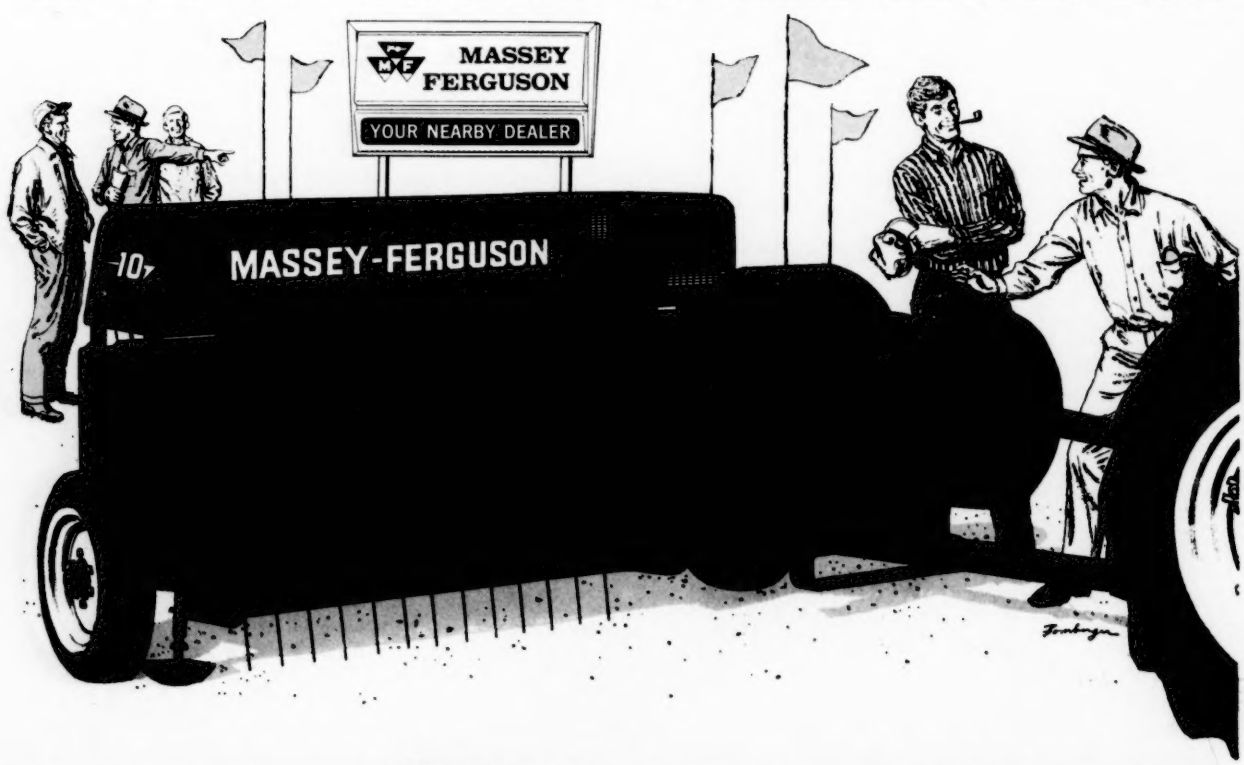
Just back your tractor into hitching position one minute, and you're off to the field the next! It's that fast, that simple—with the one-man, minute-mount Massey-Ferguson 31 Mower. And that's only the beginning! There's more speed and efficiency built into this mower than any tool you own! For instance, it quickly adjusts to various tractor tread widths. And, because it's fully mounted, you can travel to and from the field at top speed, get right through any gate, and maneuver into the tightest corners with ease. Meanwhile, you get a faster, smoother cutting action with famous Dyna-Balance drive. There's no noisy pitman to vibrate and wear out. And the cutter bar operates in any position for clean, fast work on waterways and hillsides. The MF 31 also features an exclusive variable-speed belt pulley. Lets you change knife speed in seconds—without special tools or extra parts! You can meet all crop conditions and still maintain a lively pace! Your Massey-Ferguson dealer has fast-working pull-type and improved pitman models too. And every M-F mower is available with easy Time Payment Plans. Remember—for big-capacity, high-speed mowing at its very best, try the MF 31! It's the modern mower for men on the move!

Look, Compare . . . **Massey-Ferguson** World's Largest Manufacturer of Tractors and Self-Propelled Combines

THE ONE AND ONLY BALER

THAT ENDS DAILY GREASING!

Here's the big baler that puts you first in the field—the Massey-Ferguson 10. The baler that's hard at work—and tons ahead—while the others are still being greased. The baler that's got the high capacity to keep you ahead—all day long—with its wide 56-inch pickup . . . smooth, gentle leaf-saving action . . . famous sure-tie knotter . . . and long-lasting factory-sealed bearings throughout! There's never a stop or a slow-down for bearing inspection or grease. The lubrication is sealed in. All dust and dirt are sealed out. Meanwhile the MF 10 gives you uniform, securely tied bales without a miss. Any length you want from 15″ to 50″. Any heft up to 65 lbs. For big acreage or family-size farms, here's baling at its all-around best! And it's available with PTO or engine drive, and your choice of easy time payment plans. It's the finest, fastest baler you can buy—the modern, work-saving Massey-Ferguson 10!



Look, Compare... MASSEY-FERGUSON World's Largest Manufacturer of Tractors and Self-Propelled Combines